A selection of pages from
volume. 1 and volume. 2
of

ONE FORMULA
50 YEARS OF CAR DESIGN
Gordon Murray
by Philip Porter

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50 YEARS OF CAR DESIGN

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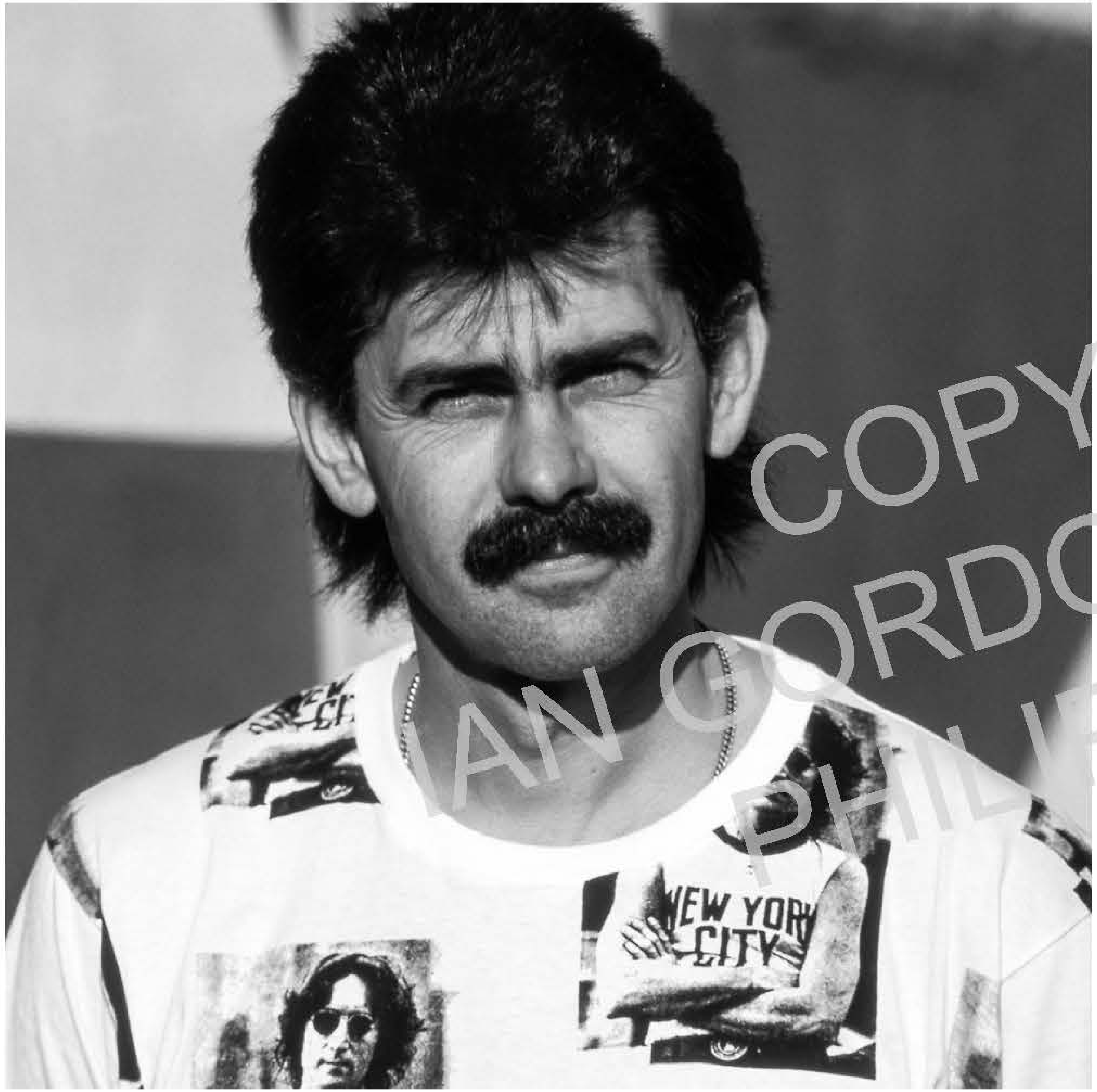
GORDON MURRAY

ONEFORMULA

50 YEARS OF CAR DESIGN

VOLUME. 1

Philip Porter



In 2017, I celebrated 50 years of car design and took time to look back on more than 70 designs, hundreds of ideas and thousands of drawings. I reflected on just how lucky I've been to have worked in an industry where I was able to live out my passion and express my creative thoughts every day of my working life.

Fifty years seemed like a good milestone to take a breath and think about doing a book. Over the years, many people have pushed me to write one, including my creative team at Gordon Murray Design. A meeting with Philip Porter in London finally allowed me to push the button. This book is not my life story – it is the story of my automotive designs, but inevitably the human side of my career intermingles with the design story. So it is, in fact, part biography – particularly the early years in South Africa. From the age of five, I was racing-car mad, largely due to the influence of my father Bill Murray, and I was never deflected from pursuing a course that would lead me to become both a race-car driver and designer.

As a teenager growing up in South Africa, Bob Dylan and Colin Chapman were my heroes. I loved Lotus not only for the design but the innovation, the ideas and the constant striving for light weight. So it is perhaps no surprise that my automotive design career followed a similar path to that of Chapman, with the exception that I have been lucky enough to have had the opportunity to design many diverse vehicles.

This book is a chronological walk through my vehicle designs, starting in 1967 with my first car, the IGM Ford, which I numbered T.1 (Type 1). Since then, I've retained the type numbering system and have only allocated a 'T' number when the vehicle was actually built, and only for the first of its type – not for a variant of that vehicle type. Designs that remained just that are referred to as 'ghost cars', and at the end of the book we've covered some other diverse and alternative designs that didn't seem to fit into the natural flow of the chronology.

The original idea with Philip was to do a fairly concise book that covered all my designs, but it became increasingly obvious, as we progressed, that taking short cuts would interfere with the flow of my design story, and some 'milestone' cars seemed to need more than just a couple of pages. All this has led us to the two comprehensive volumes that make up my story.

Both myself and the team that worked on the book had to trawl through hundreds of photographs and literally thousands of sketches and drawings, and it proved to be a difficult task selecting the best illustrations to support a particular design. What made it so difficult are two facts: firstly, I did all the drawings of my early cars myself (in some cases 500 drawings per car) and secondly, I kept everything! I do hope that you'll enjoy the book and that all the original notes and sketches will help you to understand my design process and philosophy.

One Formula has, and always will be, my approach: simplicity, light weight and innovation.

As I mentioned, 50 years seemed to be an appropriate milestone to write the book, but at Gordon Murray Design we are producing some of the most interesting and revolutionary work I have ever been involved with, so the story continues…

PROFESSOR IAN GORDON MURRAY CBE

Like many enthusiasts, I have long known, and respected, the name Gordon Murray. As I hope these books make clear, Gordon is an absolutely fascinating gentleman with such a wide-ranging spread of interests and an extraordinary range of abilities.

These volumes examine in detail all of his automotive designs, from his early work in South Africa, through his initial involvement in Formula 1 and his big break, thanks to the redoubtable Bernie Ecclestone. During his Brabham years, he gained a justifiable reputation as a pioneer, a rebel and one of the greatest designers of all time.

When Murray joined Brabham, the team was languishing at the bottom of the Constructors' table, finishing ninth (and last of those to score points) in both 1971 and '72. With Gordon's first Grand Prix car, it jumped to fourth in 1973, and second two years later. A change of power unit compromised the next few seasons, but reverting to Cosworth engines resulted in third place in the 1980 Championship and Nelson Piquet being runner-up in the Drivers' standings. In '81, the team finished second and Piquet became World Champion, a feat he repeated in '83.

After a decade and a half with Brabham, Gordon moved to McLaren as Technical Director in late 1986. During his three years in charge, the team won the Constructors' Championship twice and Ayrton Senna and Alain Prost took the Drivers' title in '88 and '89 respectively.

Gordon then chose to move away from Grand Prix racing, conceiving and designing the McLaren F1, which many consider to be the greatest road car ever produced. Remarkably, though not designed for racing, an F1 was victorious at Le Mans in 1995, beating all of the sports-racing prototypes, with examples also finishing third, fourth and fifth. F1s won the BPR Global GT Series in 1995 and '96.

Meanwhile, Gordon had designed the Rocket, which is still the world's lightest roadgoing car. Other road cars followed, including the Mercedes-Benz SLR McLaren.

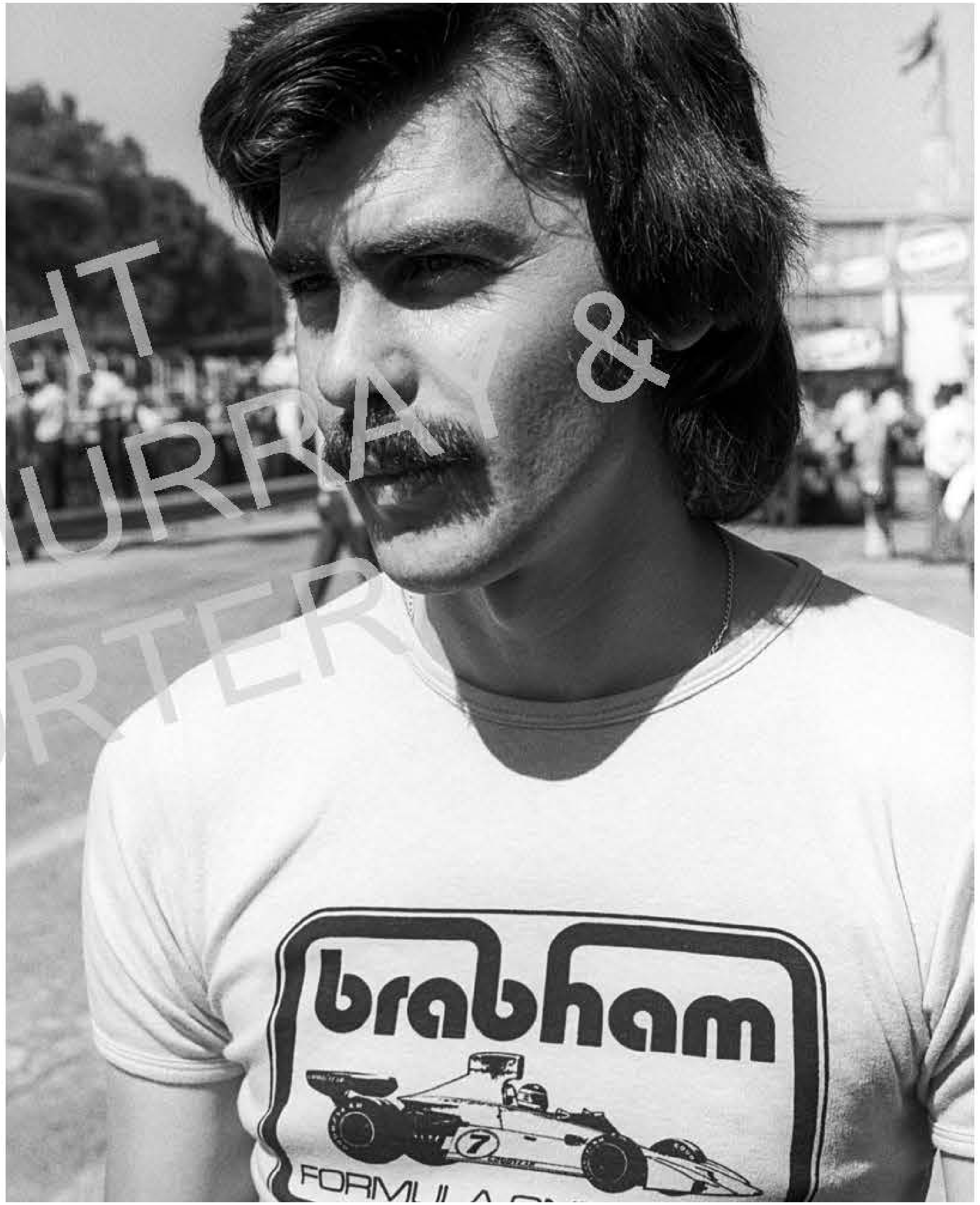
In 2007, he set up his own company: Gordon Murray Design. Since then, he has produced city cars that have humbled the major manufacturers, developed his innovative iStream manufacturing system, designed the OX (an amazing vehicle for Africa), created a new TVR, and his 120-strong team continues to work on a consultancy basis with a number of global manufacturers. Not surprisingly, the great innovator and automotive genius has several more exciting projects under way behind the scenes.

Every one of Gordon Murray's automotive designs, many described in his own words, are featured in these books. The scope of his work, and his proven success, in a variety of automotive fields is breathtaking and unique.

For me, this has been an absolutely fascinating story to document. In the past 30 years, I have written a similar number of books. With the growth of my publishing company, I find it almost impossible to write now due to a lack of hours in the day. However, when Gordon said he would like to go ahead with a book (now books!), this was one I very definitely wanted to write myself. I have long been a great admirer of this automotive genius and so it is a privilege and an honour, and a lot of fun, to have worked very closely with the great man.

There is so much depth to Gordon, from his outrageous earlier period (a rebel with a cause!) to building his pre-eminent design consultancy, and everything between. It's a truly amazing story.

PHILIP PORTER



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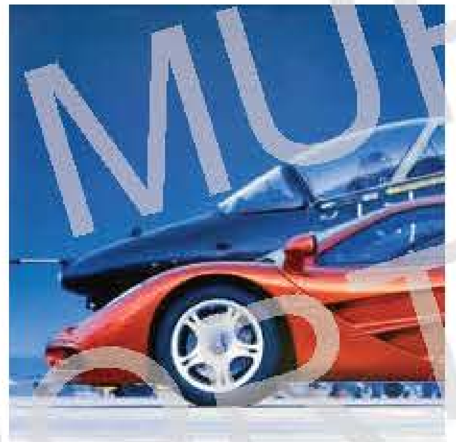

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THE EARLY YEARS

SOUTH AFRICA

1946-1969

Right Gordon aged four or five on a homemade tricycle built by his father. The helmet is Bill Murray's from his motorcycle racing days

THE EARLY YEARS

SOUTH AFRICA

Gordon Murray was born in Durban in South Africa in 1946. At that time, his father was a motor mechanic but when his parents had first met, he had been working as a chauffeur and his mother as a housekeeper. So motoring could be said to have been in at least 50 percent of his blood. In reality, it was closer to 100 percent.

'As early as I can remember,' says Gordon, 'I was interested in anything that went fast. In those days chauffeurs had to learn how to keep the cars operating, so my dad was a self-taught mechanic.'

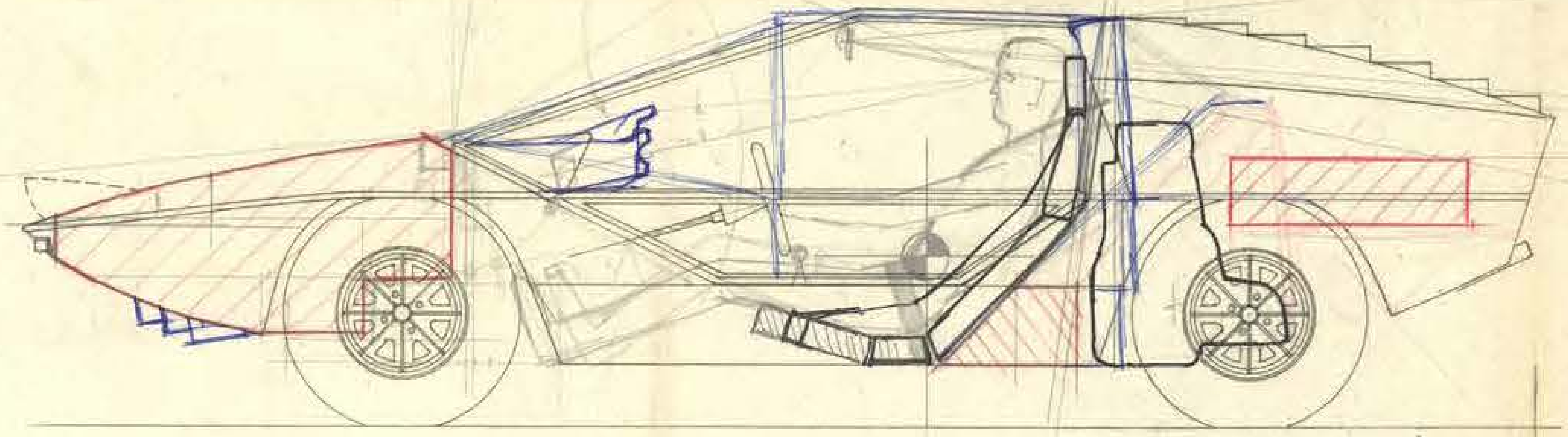
His father was one of 10 children and this had the advantage for young Gordon that he received a number of hand-me-downs from uncles. He also had an elder brother who was born before the war, the hostilities causing his father to be away for four years.

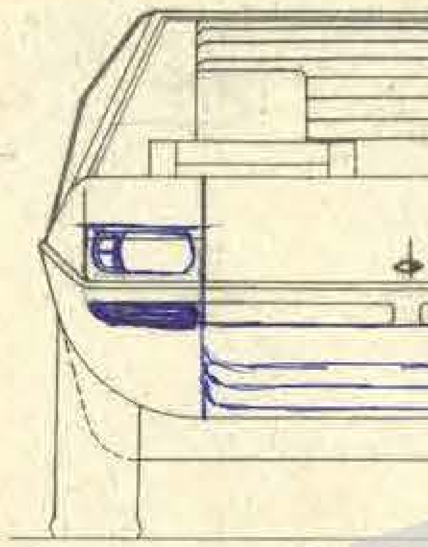
'I knew I'd be interested in design and construction from a very young age. I had this box of wooden blocks. They were just hardwood blocks of slightly differing natural colours, very worn from being handled, but all shapes that you could build into all sorts of things. My brother had it first and then I got it. I spent forever as a child creating buildings, and things that worked, and then I had a hand-me-down Meccano set from somebody and I built machines that worked.'

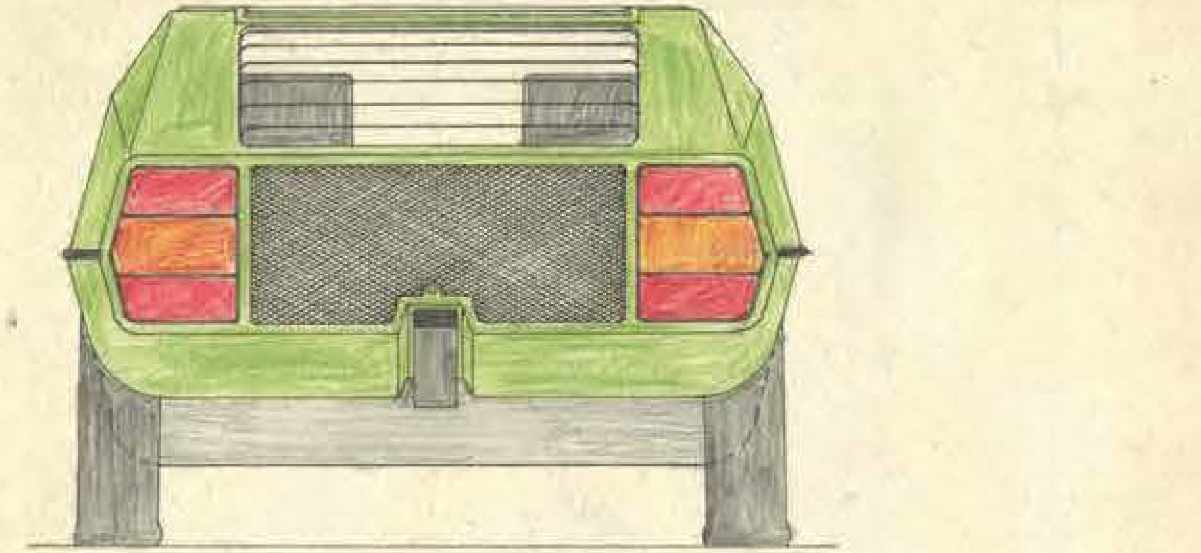
When Gordon was four or five, his father started building soapboxes for him. A soapbox was often quite literally an old wooden box with a couple of crude axles, one of which swivelled to provide the steering, and four wheels from a bicycle or some such.

'I would race them up and down Marcus Avenue where we lived. The four of us lived in a one-bedroom flat in an area of Durban called Glenwood. There was very little traffic in those days. We were on the slopes of Durban, about two miles from the sea. From there, it swept up to the posh area called Berea. So there were quite a lot of hills, and I can remember going in homemade soapboxes down these roads through the traffic and, literally waiting for a gap in the traffic, turning into the avenue.

'Some we built were like an old version of what they now call drift cars, with ball bearings for wheels. You'd come down the tarmac road and you'd have to start turning in 50 yards before the corner because they just understeered. Eventually you'd have enough friction to get around the corner. The things would slide and drift, and we did that for hour after hour after hour. It was probably quite a good lesson in handling a car in those days.'







$$\frac{[(6\times3)+(6\times15)+(6\times9)+(30\times?)-(23\times4)]\times[35]}{1728}$$

$$= \frac{(48+90+54+180+96)\times35}{1728}$$

$$= \frac{14350}{1728}$$ = 8·30 cu/ft Boot cap. say 8½ cu/ft

$$\frac{12''[(8\times?)+(9\times4)]\times 5{\cdot}25}{1728}$$ gals.

$$= \frac{2623 \times 80}{1728}$$

= 12·16 gals fuel tank capy.

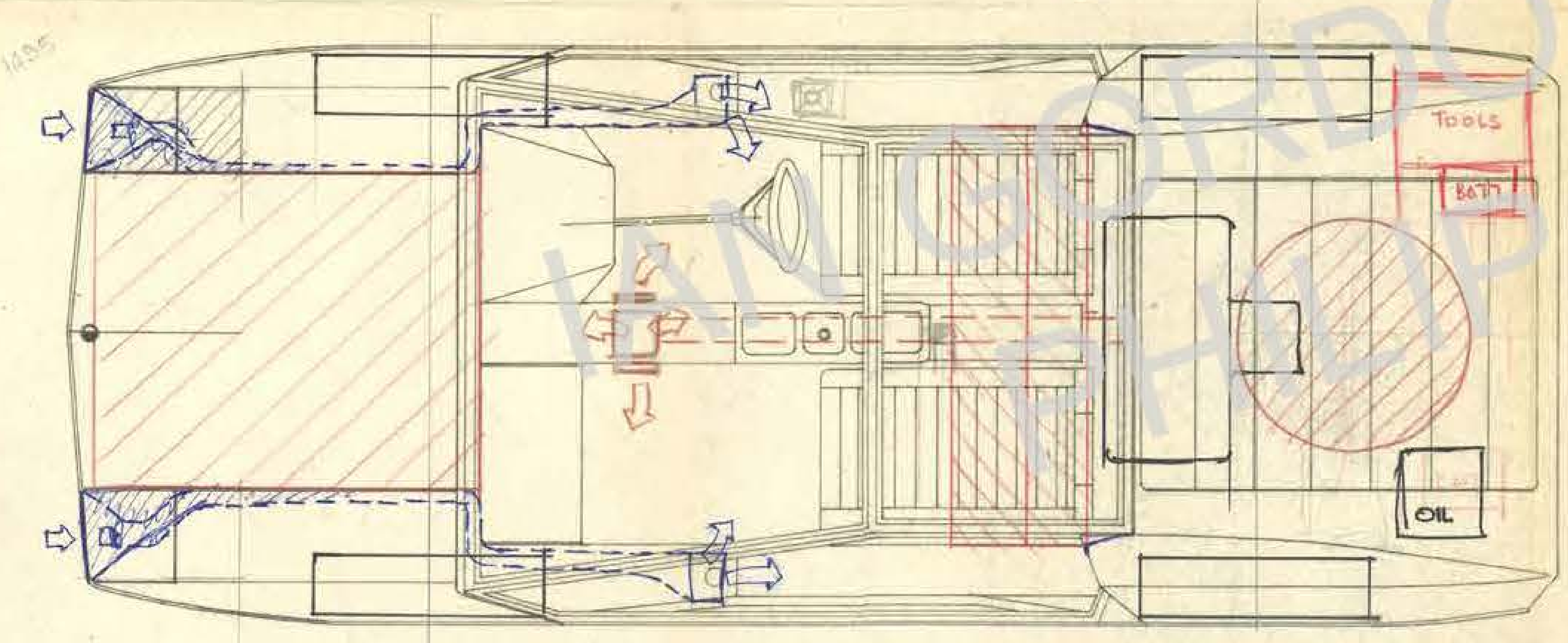
say 12 gals

EST DRAG COEF = 4+1+1+4+2+2+2+2+2

= 0.33N

= 4+1+1+3+2+1+2+1+2

(18)



Item	Y" above road	W lbs	X" behind f. axle	WX lbins	WY lbins
chassis	12	150	42	6300	1800
F. body	18	70	−6	−420	1260
Hood	32	80	30	2400	2560
R. body	24	102	90	9180	2450
Motor/trans	16	300	76	22,800	4800
R. Suspn.	15	120	84	10,100	1800
Petrol	9	85	61	5185	765
seats	15	40	55	2200	600
F/Susp.	13	150	0	0	1800
Steering	15	15	8	120	225
G/change	12	8	66	528	96
Pedals	22	20	6	120	440
battery	21	40	100	4000	840
Oil	20	15	96	1440	300
Spare	23	15	94	1410	346
Instruments/dash	21	20	13	260	420
W/motor	24	10	7	70	240
Headlights	22	10	−15	−150	220
exhaust	15	10	96	960	150
[illegible]	9	50	36	1800	450
[illegible]	18	300	42	12600	5400
[illegible]	12	20	42	840	240

WHEELBASE	7' - 0"
FRONT TRACK	4' - 1"
REAR TRACK	4' - 1"
LENGTH	12' - 7½"
UNLADEN HT.	3' - 5"
WIDTH	4' - 10"
GROUND CLEARANCE	6"
TURNING CIRCLE	25' - 0"
FRONTAL AREA	14 · 0 sq.ft.

			SCALE	1" = 1 FT.	DATE
			DRAWN	G.M.	
C	B	A			
AMENDMENTS					

CUNEO 1300 G.T.
ARRANGEMENT

I.G.M.

DRAWING

1967

IGM FORD T.1 SPECIFICATIONS

MILESTONE VEHICLE

Weight	440kg
Engine	Ford 1.1-litre 'four'
Chassis number	T1-01-67
Races	7
Wins	3

Racing achievements

Competed in sprints, hillclimbs and South African Nation Sports Cars (Class A)

Won Burman Drive Hillclimb

Won Class A Sports Car race at Roy Hesketh Circuit

Design notes

The first car to be built and raced by Gordon

IGM FORD

T.1

Above all, the young Gordon Murray wanted to be a racing driver. Being still at the start of his career, he had no money with which to buy an existing racing car, of any description. And certainly no-one was going to provide an unknown and unproven enthusiast with a car. The only answer was to build one.

Being of a practical bent and rapidly acquiring the necessary knowledge through work, college and experience, he was far better placed than most impecunious enthusiasts to bring this dream to reality.

During this period, Gordon was learning about racing-car development in Europe through magazines such as *Autosport*. He also sent for two books that were to become his bibles: *Racing and Sports Car Chassis Design* by David Phipps and Mike Costin, and *The Design and Tuning of Competition Engines* by Philip H Smith. Cosworth and Holbay tuning manuals for the Ford Anglia 105E engine and a book on Weber carburettors followed.

His first consideration was, what type of car should he build and for what class? There were no junior formulae for single-seaters in South Africa at that time so sports cars were the obvious choice. There was also another small, or not so small, matter to take into account: Gordon had now grown to be 6ft 4in.

Sports cars were split into classes, with Class A being for cars with engines up to 1,100cc. There was the added attraction of a national sports car championship. Class A it was to be.

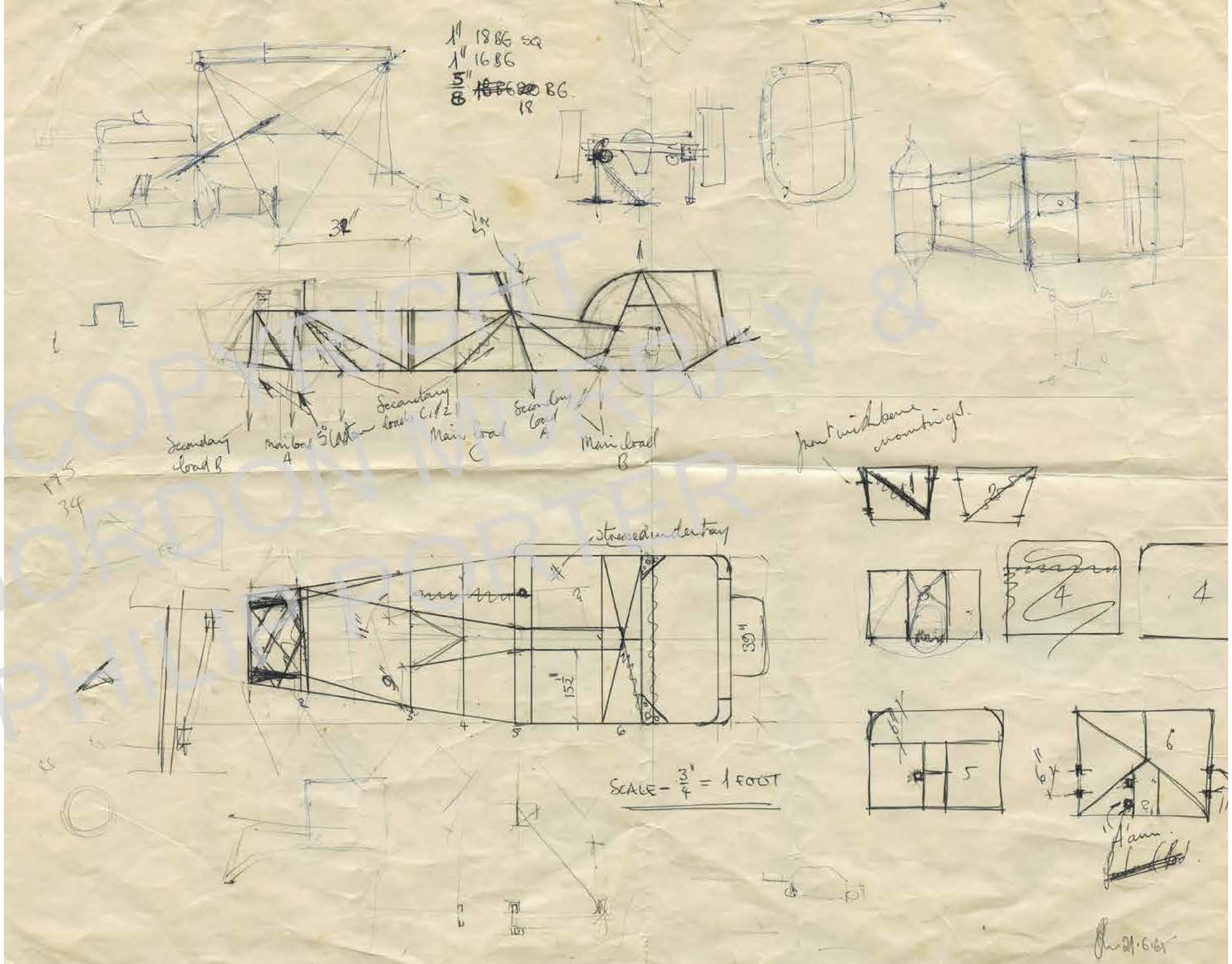
'I looked around and the quickest cars at that time were either a Lotus Seven or a Mallock U2. They were pretty quick. You had to have lights and all that sort of stuff and you had to have the wheels covered. I went around photographing the U2 and the Lotus, and then I looked at my books and I thought, right – that's what I'm going to build. I'm going build something that looks like that, but I'm not going to copy the Lotus Seven.

'The Lotus Sevens at the time weren't very well triangulated. They were quite crude because they were a bit of a production car. Chapman left out tubes to make them cheaper. I was looking around at these cars but there was no way I would fit in either of them.

'So I started from scratch and designed my own car based on something that would be eligible for Class A sports car racing, which meant I could do hillclimbs, sprints, national races, local races... I could enter anything, if I stuck to those regs.

'Then of course there was the problem of money because I couldn't afford much. You could actually go and buy an imported Cosworth engine or a Holbay engine, but it was silly money. So I decided I would do the engine myself, and everything pointed towards the little three-bearing-crank Ford 105E engine. People in England, even the Formula Junior screamers, were using that power unit and were getting massive horsepower out of them.

Right Gordon's original concept sketch for T.1 – the IGM Ford



1969

IGM FORD T.1 MKII EVOLUTION SPECIFICATIONS

GHOST VEHICLE

Weight	420 kg
Engine	Ford 1.1-litre 'four'

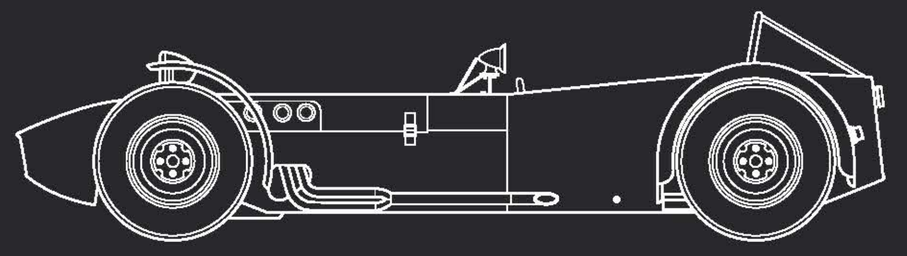
Design notes

Lower, lighter version of T.1

Design only

IGM FORD
T.1 MKII EVOLUTION

Gordon actually raced his T.1 in two guises: 'I was already, then absolutely, into evolution and improvement and stuff, and I built it much more like a Lotus Seven. The first year it was quite high with a full-height windscreen, and then the second year I redesigned it, chopped the body right down low, went to a much more lay-down driving position, saved some weight, and raced it like that in 1968. But I already had, on the drawing board, a MkII version that was even lower and lighter, and more streamlined, which I've got drawings for.'



IGM MINBUG

T.2

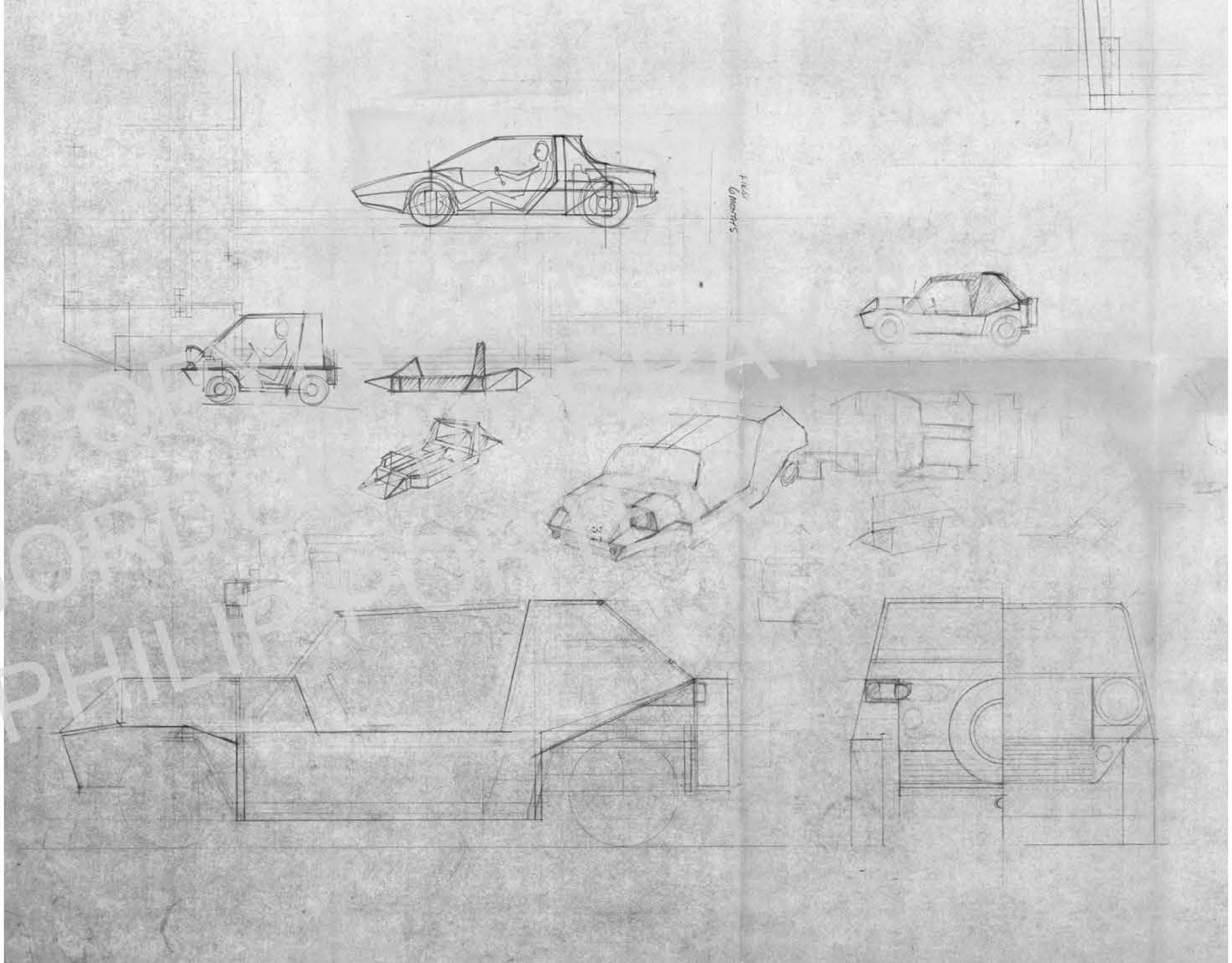
The next Gordon Murray car was born out of both frustration and necessity. The frustration was due to the fact that he had not, as yet, been entrusted with a complete car to design at Brabham, yet felt he was capable of doing more than relatively minor projects.

The necessity was due to the fact that he broke the chassis in half on his rather sad example of a Lotus Elan. On his way home from work, there was a section of road on which, at a speed of around 70mph, he could get the Elan 'to fly'. One night, he got it badly wrong! He landed heavily and snapped the chassis in two. The gent who subsequently bought it removed said vehicle on a trailer.

'When my wife eventually got her driving licence, I bought her a really cheap Mini with bent subframes that used to crab along the road at about 10 degrees. No synchromesh. Stella learned to drive on that!

'By this time, I was itching to design another car because since T1 I hadn't done any of my own cars. Brabham weren't letting me design any full, complete cars, and I felt I was more than capable. I thought what a cool thing it would be to design a little road car that would be an everyday car that I could use – my own car I had designed.

'We were living at this time in a little two-room rented flat at Claygate in Surrey and I had a drawing board, so I could draw this thing at home. In those days, there were myriad specials using Mini front-rear subframes. It was such an easy thing to do.



Right Gordon's original sketches and drawings for what would become T.2 – the Minbug. He would go on to build four of these little cars, making it his first 'production' car

BRABHAM BT36X

REPCO, HILLCLIMB CAR

'The other car I did was for a hillclimb guy called Michael MacDowel. Tauranac stood in front of me and said, "For the money he's paying us, we've got about a week to design this. If it's more than a week, we're not going to make money on it. You're doing it." It was squeezing a 5-litre Repco V8 into a Formula 2 chassis, which was a BT36 and so this became the BT36X. I did that in a week. That was my first Brabham, if you like.'

Mike MacDowel was working for Jaguar, looking after what was left of the Competition Department, when he was head-hunted by John Coombs, whose Coombs of Guildford Jaguar dealership ran a quasi-works team. His incredible roster of drivers over the years included Roy Salvadori, Graham Hill, Jackie Stewart and Jack Brabham. He appointed Mike his MD and supported his motorsport activities, which then centred on hillclimbing. Mike had on one occasion driven in F1 for Cooper and would go on to race Jaguar Mk2s and a Ferrari 250 GTO for Coombs.

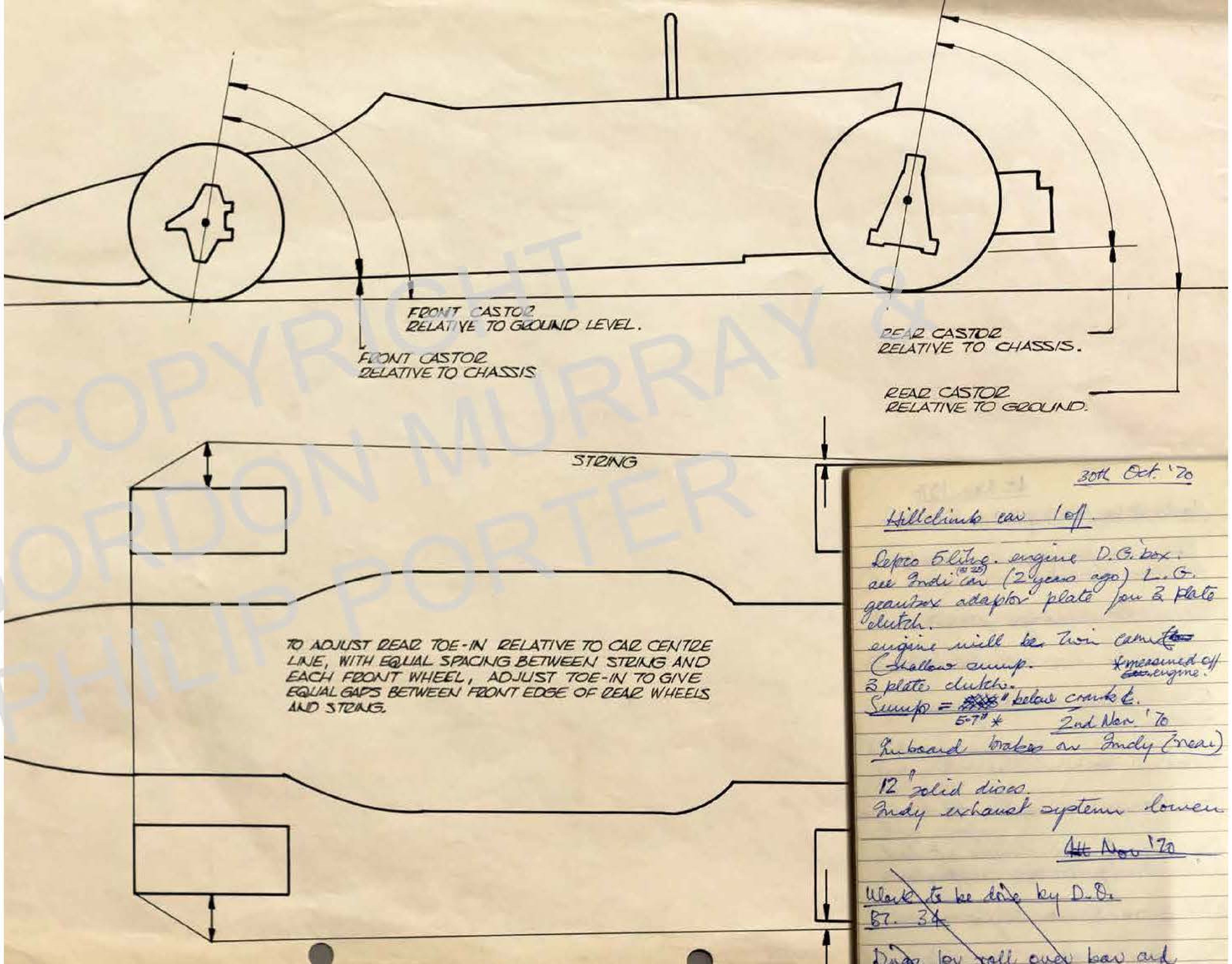
In 1967, the company prepared an E-type for a customer called Bob Jennings for hillclimbing, but Jennings could not take part in the car's first event, at Prescott, so Mike drove the car. MacDowel and Jennings subsequently shared the ex-Peter Sutcliffe Lightweight E-type for a season. At the August Shelsley Walsh meeting, Mike was standing by the start line watching the single-seaters: 'I thought, Ye Gods – that's fantastic.' He then persuaded Jennings to purchase a Chevron with a Formula 2 engine.

It's likely that John Coombs bought the Brabham for Michael – a most delightful, quietly spoken man. MacDowel explained that the BT36X was commissioned via Tauranac, 'and the young man who was let loose to do my car was Gordon Murray!'

The Repco-engined Brabham proved very effective. After three wins towards the end of the 1972 season, MacDowel and the BT36X mounted a serious challenge on the '73 British Hillclimb Championship. Of the 14 rounds, he won seven and was placed second three times. He set nine new hill records, and having lowered the benchmark at the June Shelsley meeting, he did it again in August, leaving it at 28.21 seconds – the combination of the light F2 chassis and beefy Repco V8 suited the power hill. MacDowel finished the year as Champion.

In 1974, the combination was even more dominant, taking nine wins out of 15 starts. With the Championship scoring system based on competitors' best 10 results, Michael ended with a near-perfect 99 points out of 100. Domination indeed.

Right Gordon's notes for the design of the Brabham BT36X hillclimb car. Even in the early days, he was interested in documenting procedures to help the mechanics and customers set up the cars



TO ADJUST REAR TOE-IN RELATIVE TO CAR CENTRE LINE, WITH EQUAL SPACING BETWEEN STRING AND EACH FRONT WHEEL, ADJUST TOE-IN TO GIVE EQUAL GAPS BETWEEN FRONT EDGE OF REAR WHEELS AND STRING.

30th Oct. '70

Hillclimb car 1 off.

Repco 5 litre. engine D.G. box.
see Indi car (BT 25) (2 years ago) L.G.
gearbox adaptor plate for 2 plate clutch.
engine will be twin cam
Shallow sump. *measured off engine.
2 plate clutch.
Sump = 5.7" * below crank ℄.

2nd Nov. '70

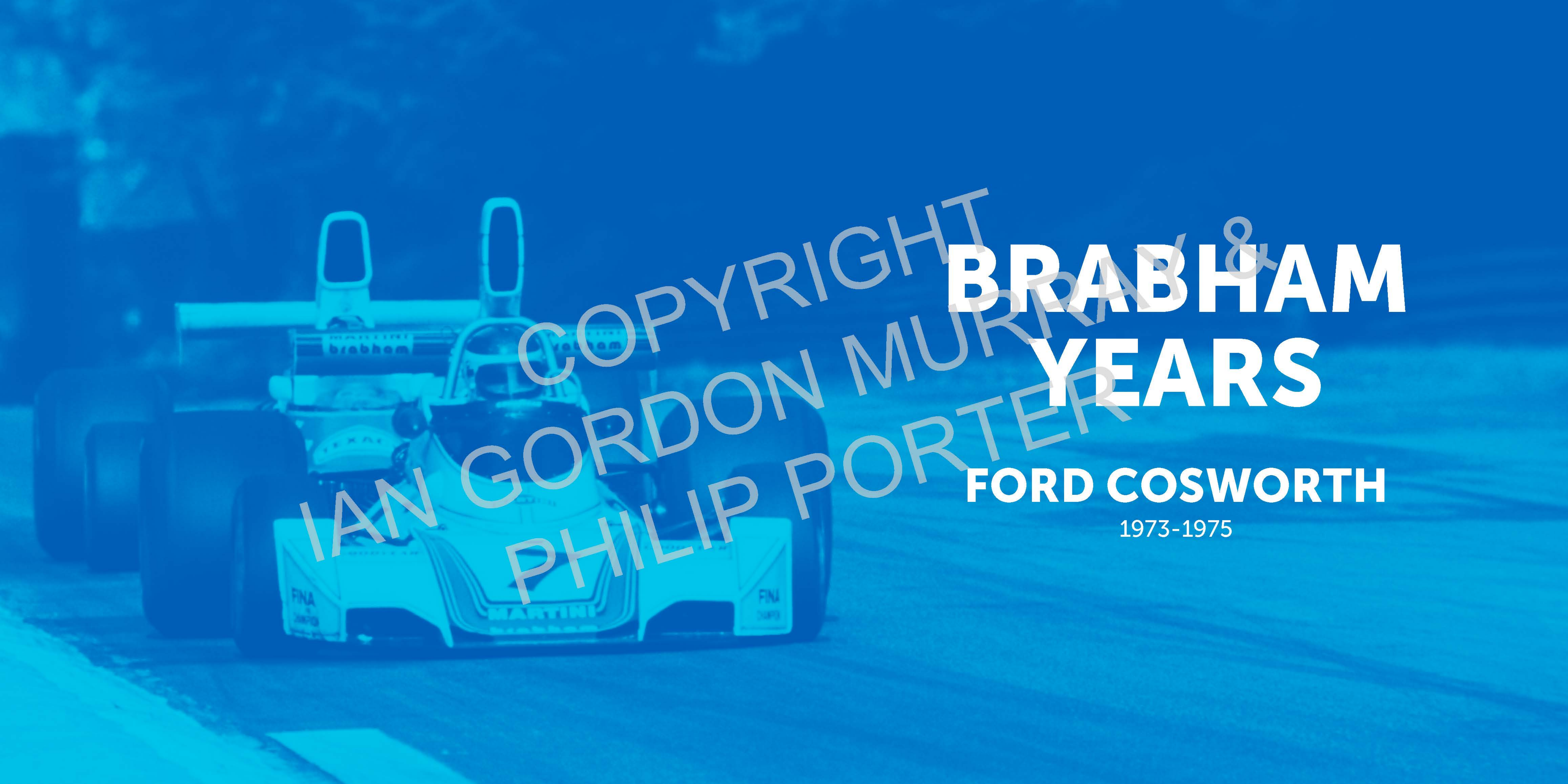
Inboard brakes on Indy (rear)

12" solid discs.
Indy exhaust system lower

~~4th Nov~~ '70

Work to be done by D.D.
BT. 34

Discs for roll over bar and



BRABHAM YEARS

FORD COSWORTH

1973-1975

Brabham began the new 3-litre era by winning the Constructors' Championship in 1966 and '67 after adopting the relatively simple and reliable Repco V8 engine, giving Jack Brabham himself and team-mate Denny Hulme respective Drivers' Championships. Main opposition to the spaceframe Brabhams in 1967 was Jim Clark in Colin Chapman's brilliant new Lotus 49, which used its engine as a stressed member.

Coventry Climax, which had powered the successful Cooper and Lotus F1 cars in past seasons, had decided not to build an engine for the 3-litre formula and this left a very large vacuum. It was filled, but not until 1967, by the new Ford-funded Cosworth DFV (double four-valve) power unit that was to be the dominant engine, with the odd interruption, for many seasons.

The motor-racing world was deeply shocked when the great Jim Clark was killed in a comparatively minor Formula 2 race at Hockenheim, but team-mate and close friend Graham Hill showed his courage and strength of character by taking the monocoque Lotus 49 to Championship success in '68. Significantly, from late '67, Lotus had lost their exclusive use of the Cosworth engine and it was now available to purchase by other teams.

One such team was Matra, whose Formula 2 cars had been run by Ken Tyrrell and driven by another truly gifted Scottish driver – one Jackie Stewart. Like Lotus, Matra used the DFV as a stressed member and, like the 49, the Matra was of monocoque construction. However, the Lotus carried fuel in bag tanks in its box-section pontoons either side of the cockpit. Matra, an aerospace company, used its experience to house the fuel in its sealed pontoons, negating the need for bag tanks. More significantly, the pontoons could house numerous lateral bulkheads, considerably improving the tub's torsional rigidity. The Cosworth-powered Matra took Stewart to his first Drivers' Championship in 1969, and the French company enjoyed the Constructors' spoils. The Brabhams, now similarly powered, took the runner-up spot.

On the aerodynamic front, the cars had sprouted high aerofoil wings during 1968 but, after a few high-profile failures, legislation tempered their height and application. In '69, Lotus, McLaren and Matra had built four-wheel-drive cars but such experiments were soon halted.

For 1970, Chapman and his fellow designer Maurice Phillippe introduced their new wedge-shaped Lotus 72. This design concentrated on maximising aerodynamics to a fresh level and creating something 'new' called downforce. It was also designed to optimise its Firestone tyres, and featured side-mounted radiators. Chapman's number one driver, Jochen Rindt, posthumously took the Drivers' title and Lotus won the Constructors' crown, followed by Ferrari and March. Brabham were equal fourth with McLaren.

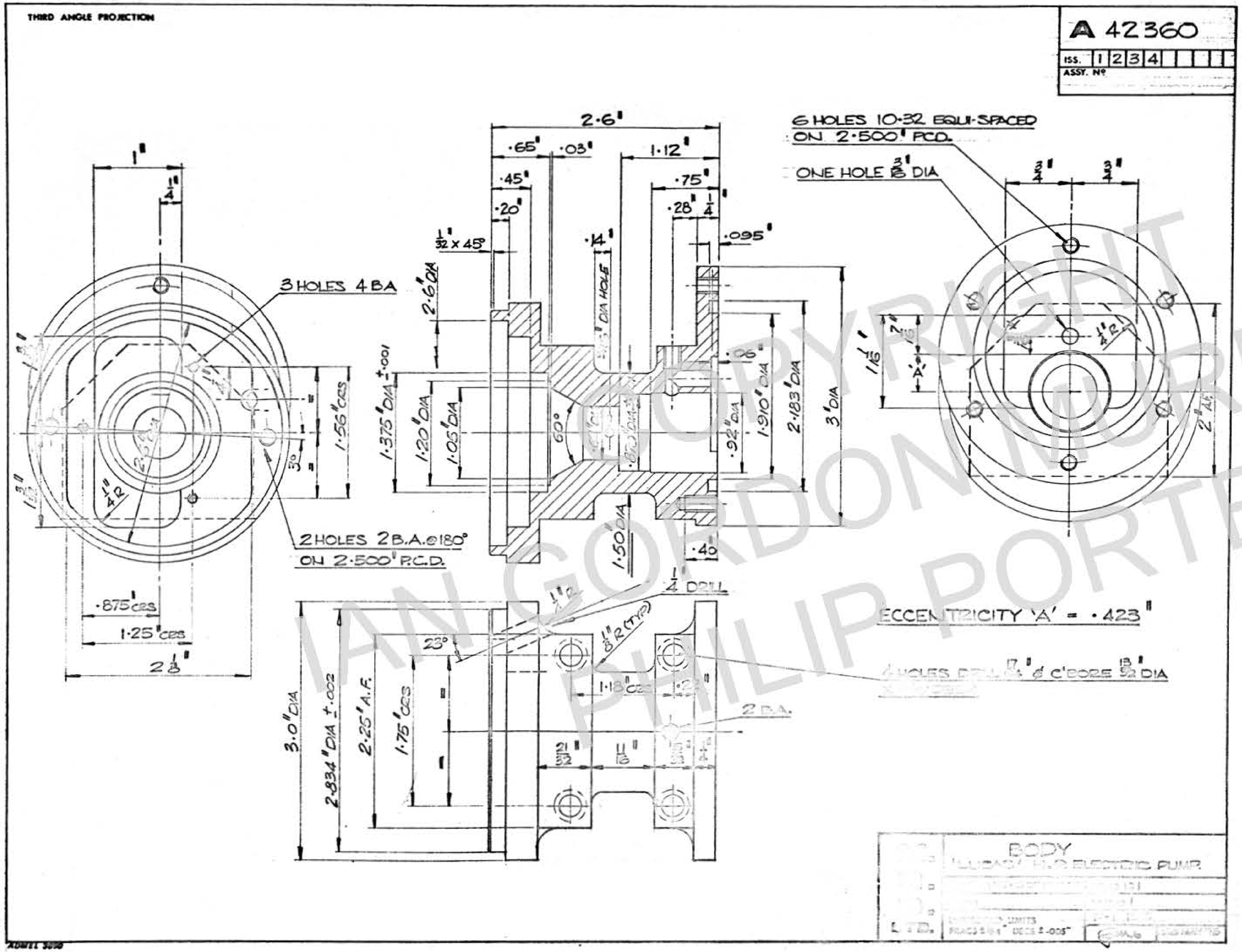
For 1971, Tyrrell for the first time built his own F1 car, designed by Derek Gardner. The resultant machine was a well thought out design and superbly prepared but there was nothing radical about it. What was exceptional was the amount of tyre testing carried out, a factor we know today to be very significant. Jackie Stewart's pre-eminent skills took him to his second Championship and the crisp new Tyrrell scored 73 points in the Constructors' standings to next-best BRM on a distant 36. Brabham languished in ninth and last place with a miserable five points.

It was then that Bernie Ecclestone stepped in and acquired Brabham, intent on improving the team's fortunes. Sponsorship now played an increasingly significant role in financing Formula 1 teams, and during the decade the Loti shed their familiar red, gold and white Gold Leaf graphics in favour of a sister brand – the sinister black and gold of the John Player Special livery. It seemed to work for Lotus and Emerson Fittipaldi triumphed in 1972. Brabham were again last.

Things could get no worse for the team. What greater challenge could a young designer face?

Right Portrait of the artist as a young man – Gordon pictured at his drawing board at Brabham's Chessington headquarters

'DURING THE EARLY DAYS AT BRABHAM, I KNEW I WAS CHIEF DESIGNER BECAUSE WHEN I LOOKED OVER MY SHOULDER THERE WAS NOBODY ELSE IN THE OFFICE'



BRABHAM BT42

FORD COSWORTH, T.5

Meanwhile, at Brabham Ecclestone and Tauranac had fallen out, and the Australian had departed in early 1972. Ralph Bellamy joined from McLaren and created the BT37, which was in essence a BT34 with a conventional radiator.

'We had a dreadful year in '72 with a hodgepodge of cars. We had Graham Hill driving for us and we ran three different cars – the BT33s, a BT34 Lobster Claw and the BT37. We didn't have spare parts for them all. It was a disaster. Even with Graham Hill, we ended up with only seven points at the end of the year, and Bernie was really miffed about that. The whole thing looked like it was going to turn to rubbish.'

For the second consecutive year, Brabham had finished ninth and last in the Constructors' Championship and those seven points compared with the total of 61 scored by Lotus, the winning constructor. At the end of the year, Bellamy moved to Lotus.

'Bernie sat me down in the office and said, `I'm firing everybody else in the design office. I'm keeping you, only you. We've had a dreadful year. I didn't go into Formula 1 to lose and score seven points. All these cars we are running are a mixture of old ideas. I'm going to make you chief designer. You've a clean sheet of paper and I want a brand-new Formula 1 car for 1973. Let's start scoring some Championship points again and be competitive.`

'I said to him, `Hold on. It's a little bit late to do a brand-new Formula 1 car.`

'So, I found myself, at 26 years old, in charge of a Formula 1 team, which thinking back was probably quite daunting, but I don't remember being worried about it. I don't remember going home at night and thinking, wow – it's all down to me from now on. It worries me now!

'I had a clean sheet of paper. Ralph Bellamy was a designer I really enjoyed working with and just before Ralph had left we had been pushing around some ideas for monocoque shapes because the DFV V8 angle was 45 degrees, and everybody else was doing round monocoques with a little local facet where the engines were mounted. We'd been pushing round an idea that the car should be triangular. So when I found myself on my own I thought, I'm going to start from that. I'm going to start from having a triangular chassis to get the fuel down low and line up the triangular shape with the 90-degree V8 cylinder heads.

After finishing last in the 1971 and 1972 seasons, the Brabham team had reached its nadir. The following year, it jumped to a more respectable fourth place behind Lotus, Tyrrell and McLaren, and ahead of March, Ferrari, BRM and others. In 1974, it slipped a place but at least took its first Grand Prix victory in the Ecclestone era. Appropriately for Gordon, it was the South African GP.

Firestone pulled out in early 1975, leaving Goodyear as sole tyre supplier, which gave Lotus a problem with the ageing 72. Ferrari had been struggling in 1972 and 1973 against the Cosworth-powered cars but began to bounce back in 1974. Having diverted their main focus to a sports car programme, they once more concentrated on Formula 1. The flat-12 engine had the virtue of a low centre of gravity and to this was mounted a new transverse gearbox that helped concentrate more mass within the car's wheelbase. Furthermore, a considerable advantage the Scuderia now enjoyed was their own test track at Fiorano, across the road from the factory. This allowed endless tyre testing to be carried out by Lauda and Regazzoni, to good effect.

Ferrari went on to be the most successful team in 1974, but in second place were Brabham with Murray's BT44B. The new car won in Brazil and Germany, and Reutemann finished third in the Championship behind Lauda and Emerson Fittipaldi, the latter now driving for McLaren.

Since mid-1974, Ecclestone had been courting Alfa Romeo and discussing using their 3-litre flat-12 sports car engine. This unit had the virtue of 12 cylinders, which produced a good amount of power, but the negative aspects were its size, weight and fuel consumption. It gave 510bhp to the DFV's output of around 480bhp. However, the Italian engine was 40kg (88lb) heavier, 28cm (11in) longer and 10cm (4in) wider. Perhaps most significantly, the fuel-tank capacity had to be increased to accommodate the extra eight to 12 gallons required per Grand Prix.

A deal had been agreed by the end of 1974 though, and rather than further developing the BT44B, Gordon had to devote much of his time during the summer of 1975 to designing the larger, squarer BT45.

The Ferrari domination continued in 1976, memorably chased by McLaren, with Brabham sinking to ninth and earning just nine points against Ferrari's 83. In spite of the Italian team being the leading constructor, it was McLaren's number one, James Hunt, who took the Drivers' title in a season during which Lauda had his horrific, fiery accident at the Nürburgring.

In 1977, Ferrari completed a Constructors' hat-trick and Lauda won the Drivers' title, but this was the year that Lotus introduced ground effect to Formula 1 and Renault entered the fray with a 1½-litre turbocharged engine. Both disruptive developments were to have a lasting impact on the sport.

Revolution was afoot in Formula 1. Seeking to replace the Lotus 72 with a concept that would transform the sport and take Lotus back to pre-eminence, Chapman and his engineering team of, principally, Tony Rudd, Ralph Bellamy and Peter Wright took aerodynamics to a new level. After much wind-tunnel testing at Imperial College London, including a tunnel with a moving belt floor, they discovered the phenomenon that would become known as 'ground effect'. Employing underbody venturis plus 'skirts' to seal the sides, the car was literally sucked down towards the ground.

The first Lotus to employ these principles was the 78, which made its début in 1977. Mechanical failures masked the effectiveness of the revolutionary development and Lotus were runners-up to Ferrari, with Brabham finishing in a not-too-shoddy fifth. The following year, the Lotus 78 began to dominate the early stages of the year and its mid-season successor, the Lotus 79, which refined the 78's design principles, completed that domination. In an attempt to combat the ground-effect Lotus, which he could not copy due to the Alfa engine being a wide flat-12, Gordon ingeniously came up with the famous 'fan car' and Brabham took their first win since 1975.

Realising that the team stood no chance without a 'V' configuration power unit, Gordon then persuaded the genial Carlo Chiti, Alfa Romeo's legendary technical chief, to build a V12 for the 1979 season.

Left Gordon and Bernie listen to Niki Lauda at Monaco. The great Austrian joined the Brabham team for 1978

BRABHAM BT45B

ALFA ROMEO

Brabham ran BT45s for the first two races of the 1977 season and Pace, who had been joined in the team by John Watson, had a revised 45B for the third round in South Africa. Watson finished third in the non-Championship Race of Champions but any celebrations were short-lived as news filtered through of Carlos Pace's tragic demise in a flying accident. He was replaced by Hans Stuck who, along with Watson, completed the season in 45Bs.

'By this time I had been joined by David North in the design office. He had come from the aircraft industry and wasn't a racing-car designer, but very, very quickly he learnt to be my number two. It was great to have somebody to bounce ideas off and we got on very well.

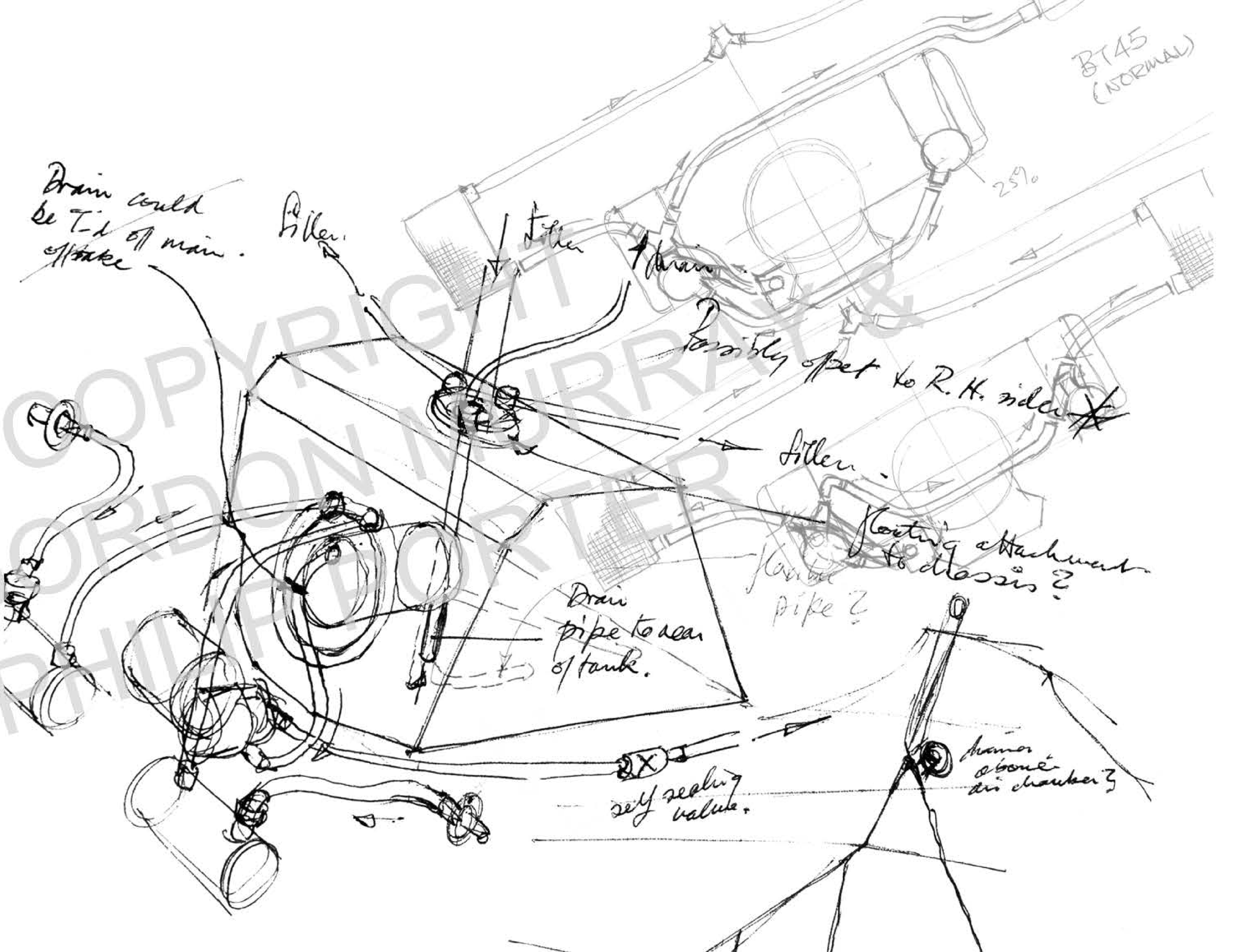
'We were getting on top of the engine fuel consumption a little bit. In an attempt to try to get the weight down, I went through the 45 and tried to make it lighter. We went to very thin 20-gauge titanium front bulkheads, and just made everything as light as possible to try to be more competitive. We still didn't get down to the weight. I think the weight limit was probably 600 [kilos], so it was still over the Cosworth cars, which were 550. So, the 45B was again an attempt to just try to lighten and tidy up, and correct any mistakes.

'One of the massive problems I had with the 45 series of cars is that when Alfa first gave us the drawings for the engine, I obviously designed the car for that. With the DFV you had a tight tolerance on the engine mountings. Every engine arrived and it just slotted on the back. Rip one out; put another on. We were testing down at Balocco with the 45 and the engine blew up, which happened quite a lot. We got the next engine out and the difference on the mountings was millimetres so it just wouldn't fit. So for the 45s generally, I had to design cams and eccentrics, and packers and spacers on all the engine mountings so that every time we changed the engine, you could adjust the car to fit the engine, which I had never had to do before. So during this time there were all these sort of 'Italian problems', if you like.'

With parallel-link rear suspension, an engine lowered 1½in and a lighter six-speed gearbox, the first half of the season was promising before things tailed off mid-year, but picked up a little towards the end.

'It was a very frustrating period, particularly as we had come from an invincible BT44 that I knew I could have kept developing. The 45B was just another year with everything getting a little bit better: the engine was getting a bit more reliable, using a bit less fuel. The car was a little bit lighter, the engine a bit lighter. They had a massively complicated titanium exhaust system, which kept splitting and breaking. We changed a bit on the wings and the aerodynamics on the 45B. We kept experimenting with different wings and wing mountings and stuff, but the basic car was the same as a 45 – the 45B was the same as the 45 in shape.'

The year had started well, with a second place for Pace in the first Grand Prix of the season in Argentina, ironically one place ahead of Reutemann in a Ferrari. Stuck finished third on two occasions but Watson, although he led four Grands Prix and was on pole in Monaco and Sweden, scored points only three times. In France, he had run out of fuel within a mile of the finish while leading, and in the British Grand Prix led the first 49 laps before succumbing to fuel-injection maladies. Brabham finished equal fifth in the Constructors' Championship.


BT45 (NORMAL)
25%
Drain could be T-d off main offtake.
Filler.
Filler
Drain
Possibly offset to R.H. side
Filler.
Floating attachment to chassis?
Flexible pipe?
Drain pipe to rear of tank.
self sealing valve.
Drains above air chamber?

Right Gordon's concept sketches for the fuel and oil systems on the BT45B. The B was a much tidier design, incorporating many changes from lessons learned during the previous season

1978

BRABHAM ALFA ROMEO BT45C SPECIFICATIONS

Weight	611kg
Engine	Alfa Romeo 3-litre flat-12
Chassis numbers	BT45C/7 and BT45C/8
Races	2
Wins	0

BRABHAM BT46B

SUCTION CAR STUDY WITH EJECTORS

'After we were forced to withdraw the BT46B fan car, I was really miffed, as you can imagine. I knew how ejectors worked and they're quite powerful tools. If you can design the perfect venturi and diffuser, from the middle of the venturi the low pressure can cause much more air around that area to be sucked through – up to about five times the amount of air.

'So I tried something really wacky. As we had the fan car already finished, with all the difficult bits like sealing the skirts done, I built an ejector car. David North and I were working on this and I did a calculation and it showed, in theory, that we could get the same unit suction from the exhaust system that we had from the fan.

'I built this eggbox on the back of the car that was probably about 600-700 millimetres square – looking at the car from the back – broken up into, let's say, 36 square compartments. It was like a chip maker, a grater sort of thing. And then – it was so complicated – I took the exhaust and broke it into 36 tiny little exhaust pipes, and ran each of those into the 36 square compartments.

'It would be just like the fan car because the suction would be engine-speed related. Everything would stay the same. And there were no moving parts. We took it up to Silverstone and tested it, and sure enough it made downforce – you could see just by revving the car that it was moving up and down. But unfortunately we'd totally destroyed the engine power, even though the total volume of the exhausts was the same plus 20 percent for losses – because you get more boundary layer losses as you go smaller.

'I'd got the same overall diameter, and you have to add a percentage because as you go smaller you get more frictional losses in the pipe. I'd done all those sums so in theory it should have been right. But with the restriction it was probably affecting the pulse upstream in the exhaust system, and the car was very slow. I don't know how much power we lost, we never measured it, but it was probably significant – 40 or 50 horsepower or something. By then I'd run out of time because we were moving on to the next race.'

DAVID NORTH COMMENTS

'Gordon designed a very neat chassis for BT48, as narrow as Lotus's but probably stiffer, and incorporating carbon fibre panels for the first time. And he produced a compact pull-rod front suspension, using curved tracks to control the locus of the spring/damper units rather than conventional rockers. This was lighter, stiffer, and more streamlined than Lotus's traditional rocker arrangement. I did the rear suspension, which was also a pull-rod design.

'But the rear brakes were a problem. Everybody in those days used inboard rear brakes, with the calipers usually bolted to the side covers of the gearbox. Lotus had made this much more compact by casting the calipers integral with the gearbox. I was reluctant to copy this – it looked complex and expensive – so I moved the brakes outboard and mounted the calipers on special rear uprights, which also necessitated new recessed rear wheels instead of the usual bobbin style. This resulted in more space for airflow past the gearbox and suspension than Lotus enjoyed, and kept the hot brakes away from the vulnerable gearbox.

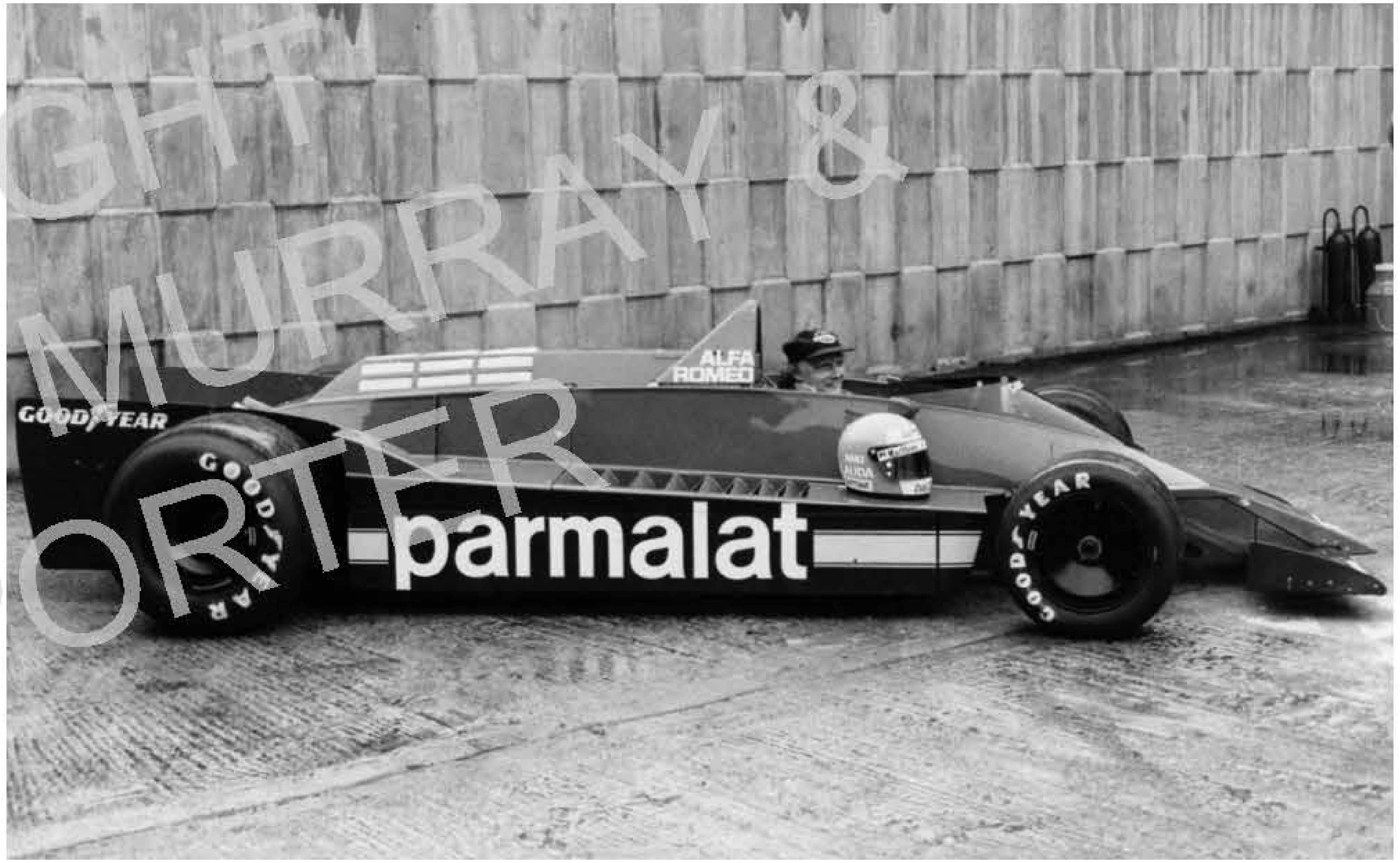
'Our approach was deemed very risky – it was a well-known 'fact' that you had to have inboard brakes to minimise unsprung weight. But within a year or so everyone copied our arrangement, which persists to this day.

'The aero package was complemented by a novel design of skirt, designed by yours truly. Unfortunately, the car was a disaster at the first race [Argentina] of 1979. It produced very little downforce, and the skirts didn't work.

'I was sent home to design a better skirt system in time for the following race, and Gordon revised the aerodynamics towards a more conventional layout with short sidepods, more like Ligier's. Brazil was a lot better for us than Argentina but we were still miles behind the leaders.

'Around this time we started to use the 7ft x 5ft wind tunnel at my old university, Southampton. Several teams were beginning to use wind tunnels but Southampton had the unique feature, at that time, of having a moving ground plane – the aerodynamic behaviour with the moving ground was far more realistic than without. Most teams designed their 'underwings' by copying an aircraft wing section from a textbook, but this was completely inappropriate for operation close to the ground. We developed our underwing shape by trial and error, measuring pressure at lots of points under the car and adjusting the curvature until we achieved an optimum pressure profile over the entire under-surface. We eventually developed a profile called 5B, which we used unchanged for a couple of years – it was that good.'

Above Lauda describes the BT48's handling to Gordon!



Above A low rear wing was experimented with, but the car was never raced in this form. The BT48 was the first Grand Prix car to incorporate carbon fibre within its monocoque

BRABHAM BT49

FORD COSWORTH, T.11

'By this time Bernie, myself and the drivers were getting fed up with the inconsistencies with the Alfa engines and the fuel consumption, and the weight and everything else. It looked like we were going to have a parting of the ways.' Furthermore, Autodelta were developing their own Formula 1 car, so their focus was increasingly on that.

'Bernie said to me, 'I'd like to see how good this car is with a DFV again because we don't know where we are, we don't know how much is the car and we don't know how much is Alfa.'

'This was mid-to-late 1979, so I sawed 4½in off the back of a BT48 and made a new bulkhead to accept a Cosworth. The front end was a 48 and we just bolted the back end on again with the DFV and ran the car, and it was immediately much, much quicker. We went to Canada and Piquet qualified on the second row. The drivers said, 'Yeah, this car's fantastic'. We'd been held back by the engine, really.'

The revised car was 35lb lighter than the Alfa-engined 48 and, with the DFV's lesser fuel requirement, some 95lb lighter with fluids onboard. Piquet held third place for a number of laps in Canada before being halted by gearbox problems. This is the race at which Lauda decided to walk away from Formula 1. His replacement was Ricardo Zunino. For the next race, the last of the season, Piquet was on the front row of the grid, second fastest, and set the fastest lap before a driveshaft broke.

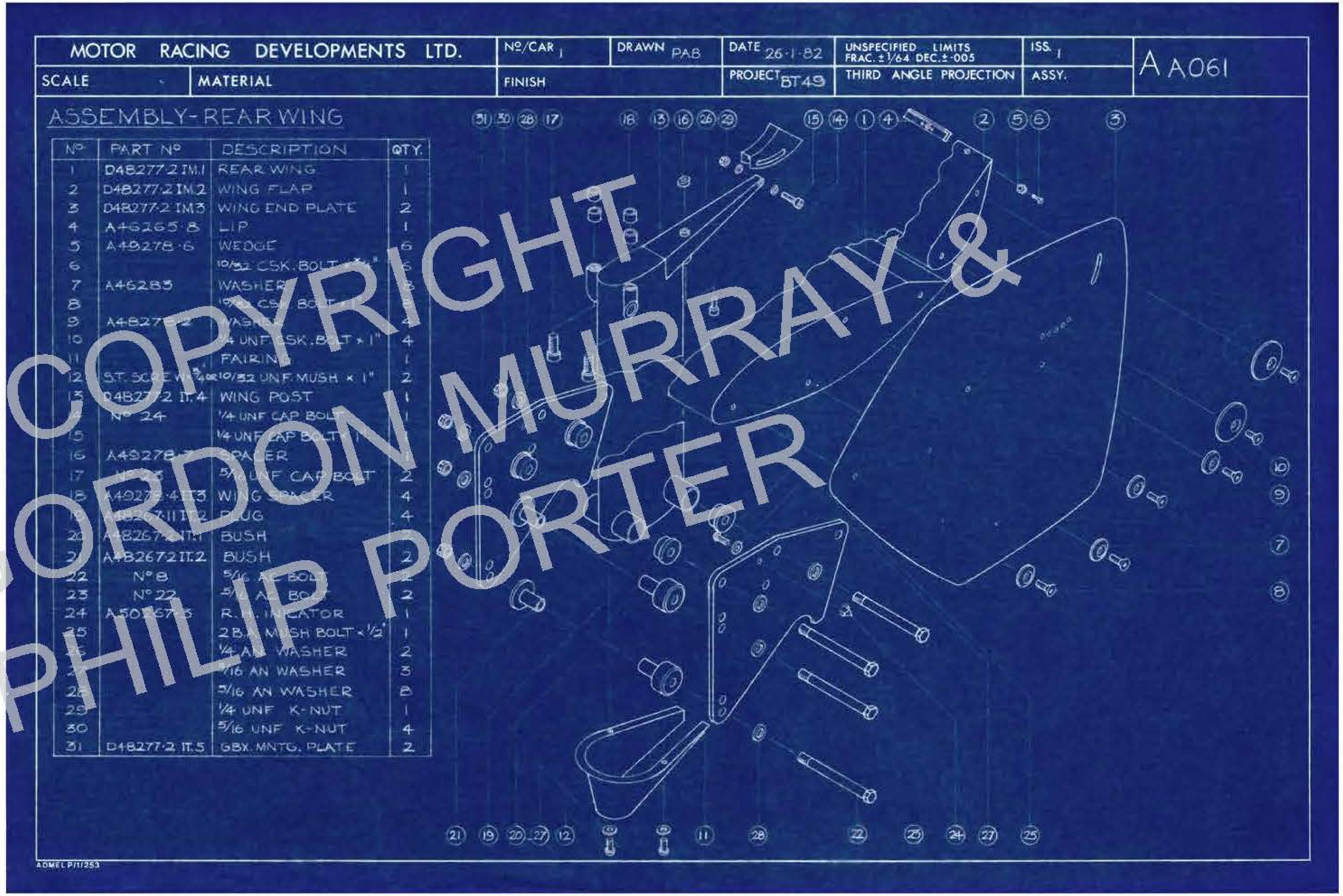
During the winter, Gordon refined those hurriedly modified cars that had been entered in the final two races of 1979. Free from the complexity of the Alfa engine, he returned to his original design philosophy of simple, light and easy-to-work-on cars. The BT49 was therefore designed more in line with his neat BT44 – the Alfa Romeo years had forced a departure from this path.

'David and I had learnt a lot about ground effects and sliding skirts on the 48, and now we had a wind tunnel and a carbon factory. The 49 was an incredibly advanced, stiff, easy-to-drive motor car. Easy to work on, too – the mechanics loved that little car. The drivers loved it and all through the first year of the BT49 we kept developing the ground effect and the downforce – the number of kilos we were making, if you like.'

The BT49 incorporated more carbon panels than the BT48 because Gordon was learning more about the material. The monolithic carbon fibre panels were bonded and riveted into the monocoque, forming a hybrid primary structure with the aluminium panels. This resulted in an increase in the torsional stiffness of the chassis.

'As we progressed through the BT49 variants, I introduced more and more carbon. What stopped me stone-dead in my tracks in the first year of the BT49 was that we had two minor crashes at Monaco in the rain. Thirty miles an hour into the barrier. The way the carbon failed was pretty gripping – it didn't buckle, it was catastrophic. It just sheared and shattered. I didn't like that. To this day I don't know how I managed it, but I talked Bernie into crashing a full-sized BT49 – the first Formula 1 car ever crashed under controlled conditions. We went to BMW in Munich and they put a dummy in the car and crashed the 49 into a concrete block.

'We analysed how the carbon failed and, because I wasn't happy with the way it failed, I introduced a hybrid sandwich of Kevlar and carbon into the next BT49.'



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ASSEMBLY-REAR WING

N°	PART N°	DESCRIPTION	QTY.
1	D48277·2 IM.1	REAR WING	1
2	D48277·2 IM.2	WING FLAP	1
3	D48277·2 IM.3	WING END PLATE	2
4	A46265·8	LIP	1
5	A49278·6	WEDGE	6
6		10/32 CSK. BOLT × 3/4"	6
7	A46285	WASHER	[illegible]
8		10/32 CSK. BOLT × 1"	[illegible]
9	A48277·2	WASHER	4
10		1/4 UNF CSK. BOLT × 1"	4
11		FAIRING	1
12	S.T. SCREW × 3/4 OR	10/32 UNF MUSH × 1"	2
13	D48277·2 IT.4	WING POST	1
14	N° 24	1/4 UNF CAP BOLT	1
15		1/4 UNF CAP BOLT × 1	[illegible]
16	A49278·7	SPACER	1
17	N° 25	5/16 UNF CAP BOLT	2
18	A49278·4 IT3	WING SPACER	4
19	A48267·11 IT.2	PLUG	4
20	A48267·2 IT.1	BUSH	[illegible]
21	A48267·2 IT.2	BUSH	2
22	N° 8	5/16 AN BOLT	2
23	N° 22	5/16 AN BOLT	2
24	A50267·3	R.H. INDICATOR	1
25		2 B.A. MUSH BOLT × 1/2"	1
26		1/4 AN WASHER	2
27		7/16 AN WASHER	3
28		5/16 AN WASHER	8
29		1/4 UNF K-NUT	1
30		5/16 UNF K-NUT	4
31	D48277·2 IT.5	GBX. MNTG. PLATE	2

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Right A Paul Burgess drawing for the rear wing, which remained pretty much unchanged across the entire BT49 family

The 1980 season had started well, with Piquet qualifying fourth and finishing second in Argentina with his BT49, which proved to be the fastest car in a straight line. The rear suspension had been revised for this race, the sidepod profiles and fuel system modified, the radiators repositioned and a new skirt system adopted. In South Africa, he qualified third and finished fourth. At the USA West GP, however, it all came together – Piquet was on pole and led from start to finish to record his first Grand Prix win.

He went on to finish third in Monaco and fourth at Paul Ricard, while Héctor Rebaque replaced Zunino from the British Grand Prix onwards. Although Piquet finished second there, Brabham could not compete with the stronger Williams line-up of Alan Jones and Carlos Reutemann in compiling Constructors' points, but nevertheless Jones and Piquet were battling for the Drivers' crown.

Throughout the season, Murray and North continuously developed the ground-effect aerodynamics. During practice for the Austrian Grand Prix at the Österreichring, Piquet had a high-speed accident at the Bosch Kurve when one of the sliding skirts stuck. For round 11, the Dutch Grand Prix, the 49's wheelbase was lengthened by three inches, new sidepods designed to suit, and revised front suspension adopted. These changes resulted in increased maximum speed without sacrificing downforce. After Jones damaged his car's skirts early on, Piquet took victory and closed to within two points of his Championship rival.

At Imola for the Italian Grand Prix, Piquet led Jones from the fourth lap and finished nearly 30 seconds clear. Piquet had now amassed 54 points to Jones's 53 with two races to go. In Canada, the rivals shared the front row, with the Brabham on pole. They collided at the first corner and the race was stopped. Piquet's BT49 was too badly damaged to use at the restart, so he had to use a spare fitted with a qualifying engine. He led from lap three to 23 when the DFV cried enough. Didier Pironi, in a Ligier, won on the road but was penalised one minute for jumping the restart, handing victory to Jones and clinching the Drivers' title for the Australian.

Jones and Reutemann took the two top spots at Watkins Glen and Williams comprehensively won the Constructors' Championship. With their stronger driver line-up, Ligier were runners up and Brabham, though they had the fastest car by the end of the season, were only third because Piquet scored all but one of their 1980 points.

Right The war between FOCA and governing body FISA gathered pace in 1980. Politics led to practice being stopped at the Spanish Grand Prix, which in turn led to an impromptu football match

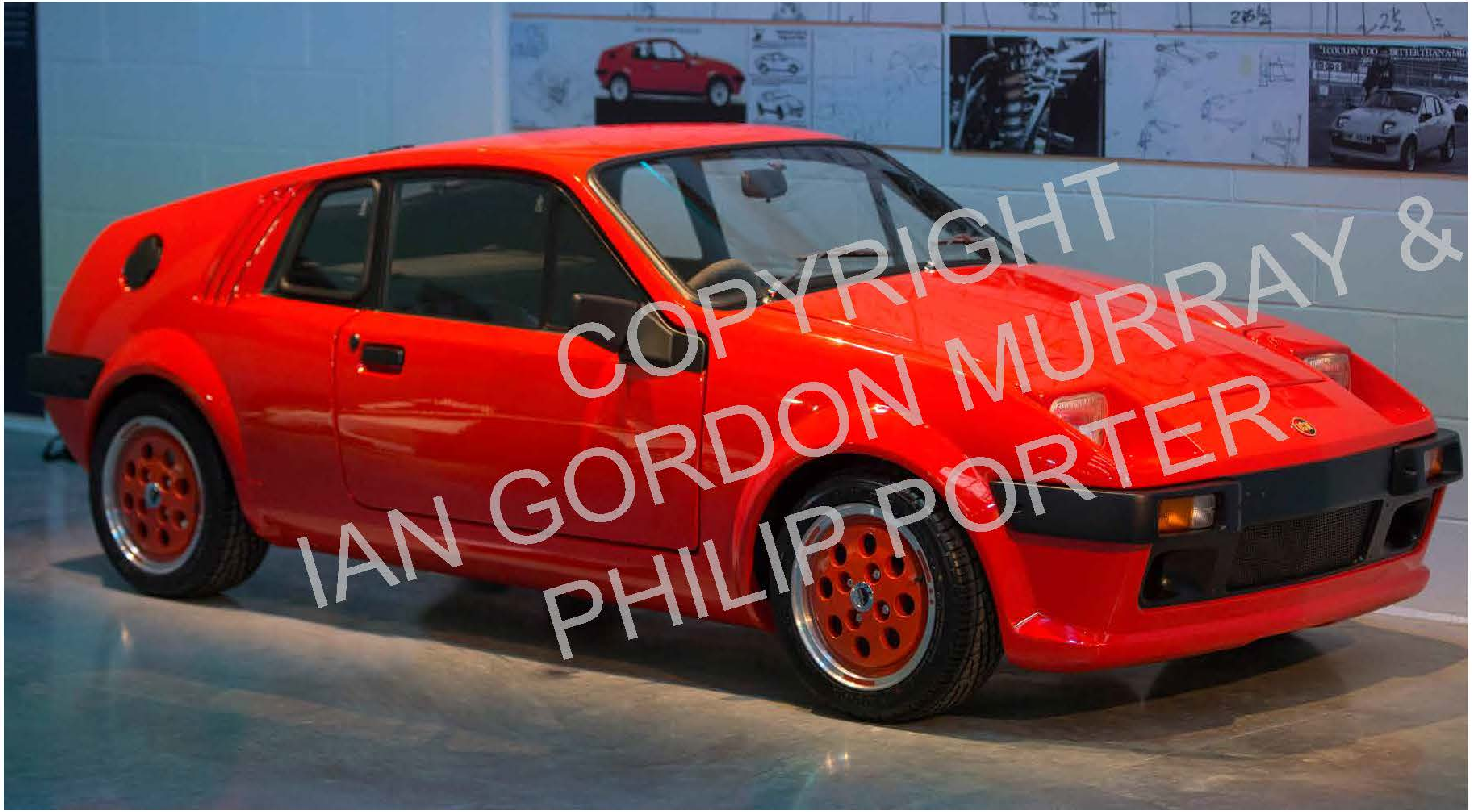
1980

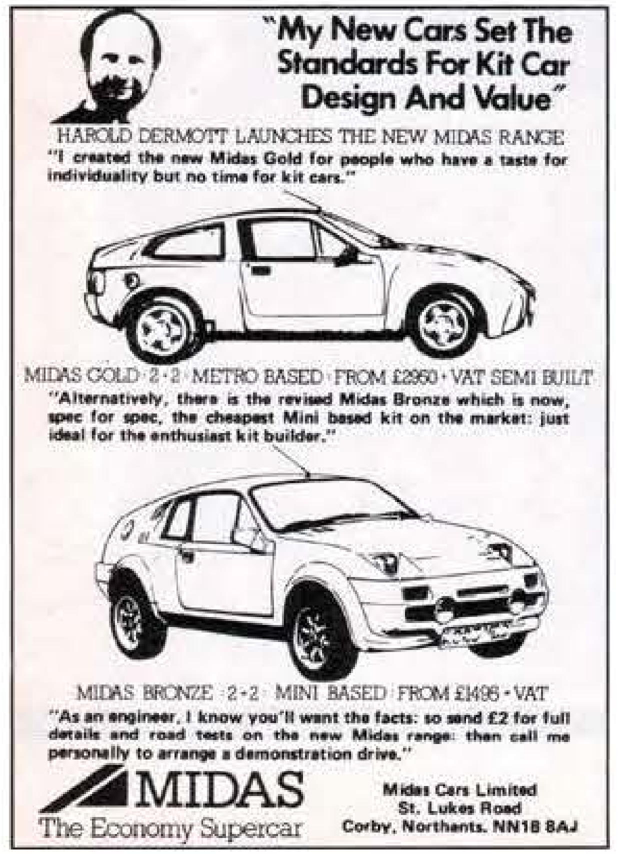
BRABHAM FORD COSWORTH BT49B SPECIFICATIONS

Weight	577kg
Engine	Cosworth 3-litre V8
Chassis numbers	BT49/2, BT49/3, BT49/6
Races	9
Wins	0

Design notes

Transverse six-speed transmission





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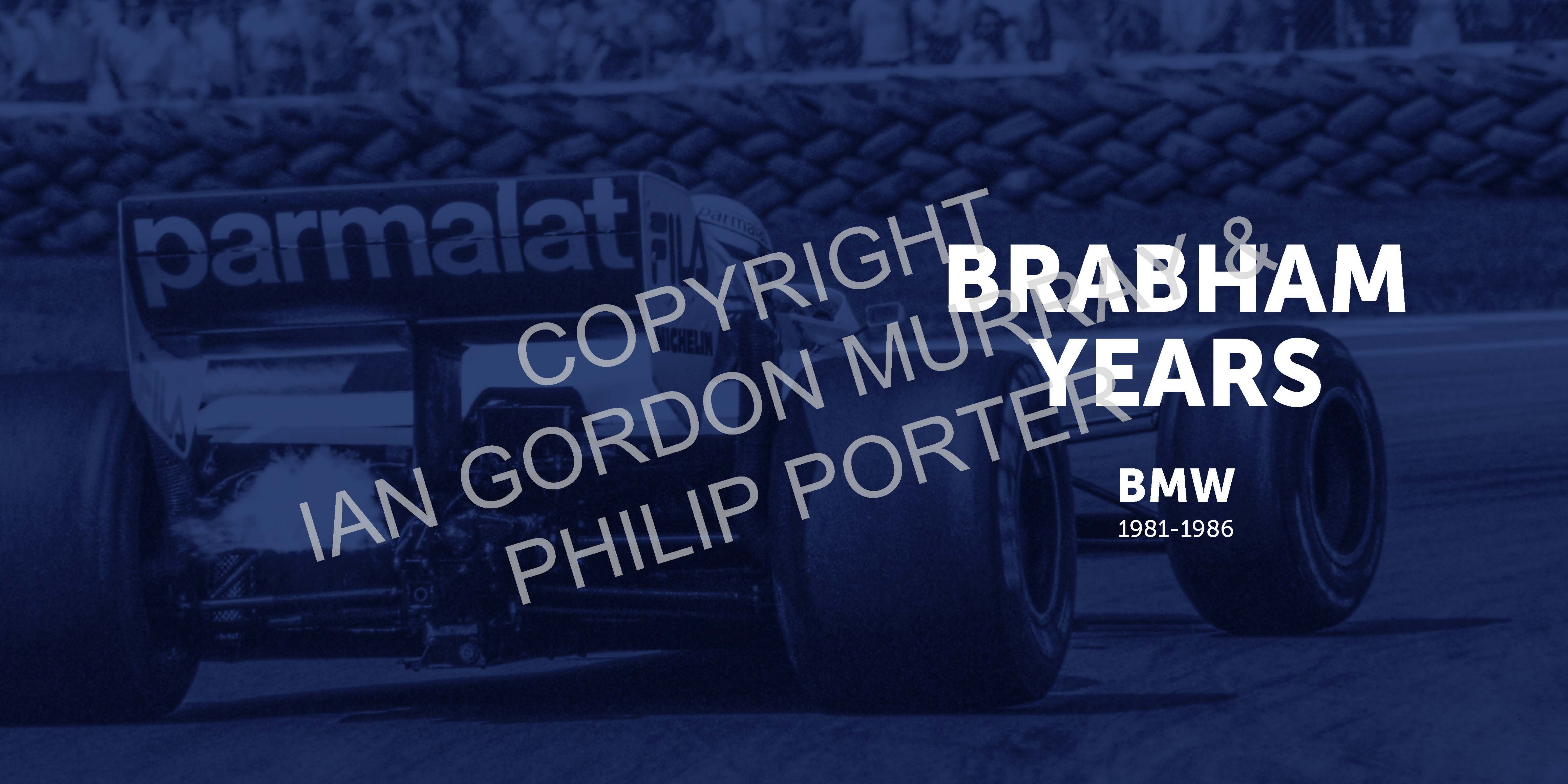
Above The Midas suspension was put together in the Brabham prototype shop!



BRABHAM YEARS

BMW

1981-1986

BRABHAM BT49T

BMW TEST CAR

'Bernie was quite astute; he was very good at looking forward and saying, "We should go to 12 cylinders" or "We need to start looking at a turbo engine."

'We scouted around and there was nobody, really, outside Renault who were interested – except for BMW. That's when I met [BMW engine designer] Paul Rosche. Up until then, in all my working life, I hadn't really worked closely with an engine designer, even though I was an engine guy. That's not strictly true because I knew Keith Duckworth pretty well and we talked from time to time, but really just in passing. I never had a personal rapport with an engine designer until BMW.

'We shot across there and met everybody and they were all incredibly personable and enthusiastic, and instead of plugging us into the belly of the main BMW company, they put us into the small BMW M-Sport department, as it became known. It was then a tiny little group of 120-140 people total and their leader was Paul Rosche. Paul and I just clicked. We both loved racing, we both wanted to win and we both loved a beer and a pretzel. We just became really good mates.

'We discovered that the engine they were putting forward was a standard 316 or 318 cast-iron block four-cylinder with a single turbo, which was absolutely taboo even in those days. Everybody was going to twin turbos. Even though I liked Paul a lot, I stared at this thing – an old four-cylinder with one big turbo. Roche is famous for knowing his oats so I thought, why not? Paul says he thinks he can make it work and we don't have another option, so Bernie and I went, `Right, we'll go for it.`

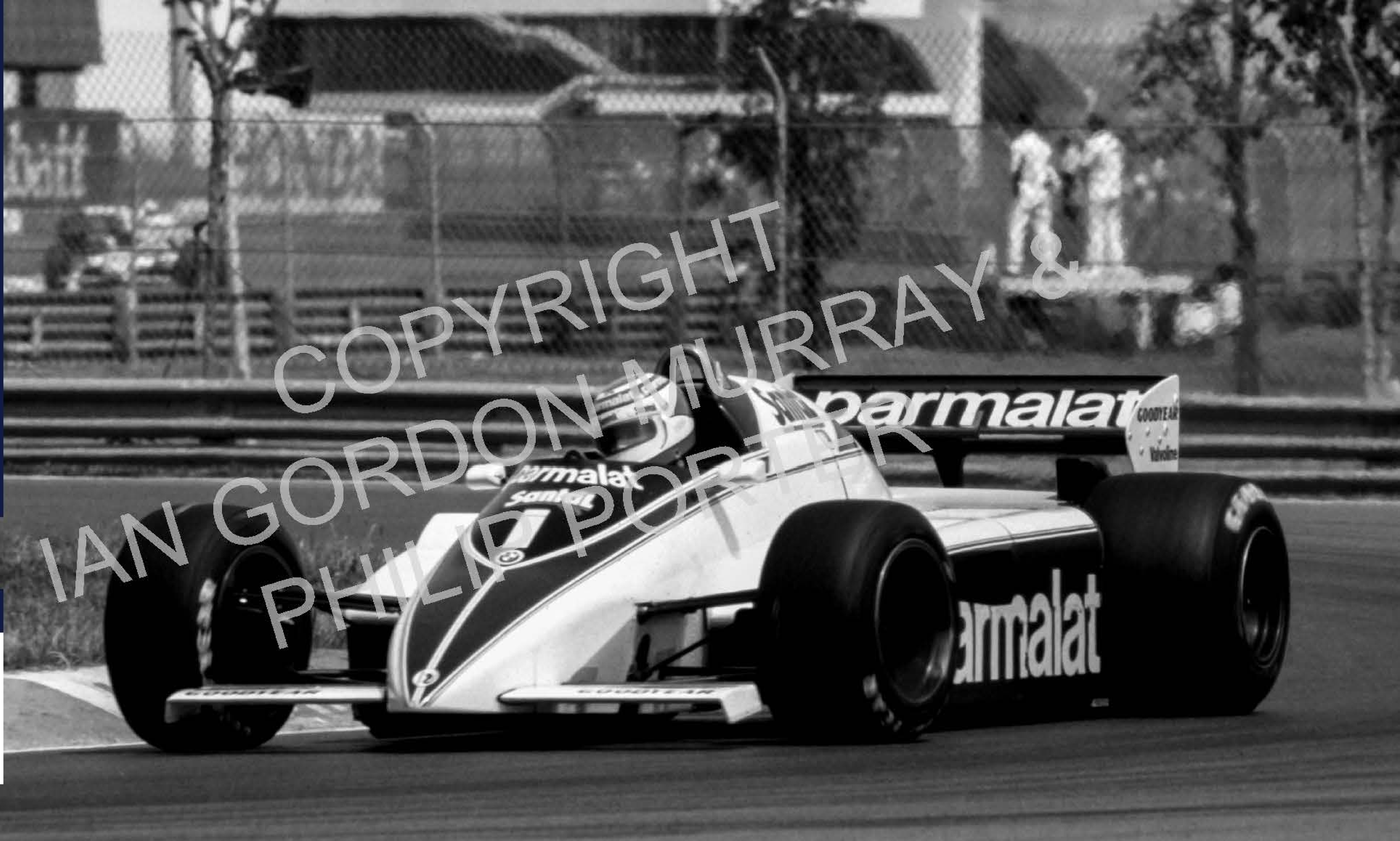
'Bernie was very keen, and so were BMW, to test the engine before we got serious. Before the end of the season we decided to build what we called the 49T.

'Then I had exactly the problem as I had with the Alfa all over again. Because it was a thin, narrow four-cylinder engine, you couldn't use it as part of the chassis. If you mounted it a certain way it was deep enough to be quite stiff in bending, but it had no lateral stiffness and the torsional stiffness was less than the DFV. The DFVs had a nice wide block and this thing was a little narrow block. I had to try to design a chassis that partially used the engine and partially had tubular support. So it was half Alfa – it was more like going back to the Weslake V12 in the Formula 2 car. I used some of my experience from that chassis to design this chassis.

'I did again what I did when I changed from Alfa to Cosworth when I modified the rear of the chassis and bolted the Cosworth on. This time I made a special bulkhead for the BMW engine. Paul and I together designed an aluminium plate on the front of the engine that matched up with the chassis. Then I came up with some tubes that went down to the back of the engine or the gearbox, to give it some lateral stiffness and some torsion, and we bolted one of these on the back of the 49 and we went down to, I think it was Paul Ricard, and it was pretty undriveable.

'Nelson found that a normally aspirated DFV is nice and progressive. This thing, when the turbo eventually spooled up, was quite violent. It had a very early electronic ignition and engine control box on it, which was like a big biscuit tin. There were huge flames coming out on the overrun; it was very spectacular.

'I didn't think the torsional stiffness was good enough – it was my first stab at this non-structural engine. Anyway, it felt powerful enough and we felt confident enough to say, `OK, let's go with it`. So the 49T was quite pivotal. We only made one, and it was a hacked-up 49, but it was a car that said yes or no to moving to BMW and a turbo, so it was quite an important car.'



1982

BRABHAM BMW BT50 T.13 SPECIFICATIONS

Weight	590kg
Engine	BMW 1.5-litre turbocharged 'four'
Chassis numbers	BT50/1 to BT50/4
Races	13
Wins	1

Design notes

First Brabham turbo car

'The guy in the car said, 'There was a bit of a bang in the back.' And we were all standing around in shorts and T-shirts. Slowly but surely this huge cloud of vapour came down and we all got wet with this fine vapour of petrol. In those days there were people walking round the pits smoking and the whole team could have gone up in one orange fireball!

'For the wheel changing, we immediately went to air guns, and very quickly started designing air guns with a trapped nut so the nut was in the gun. You spun the old nut off and it just flew out – you had another gun already with the nut in and you just ran it on. It had a pin that sprung into the clip so it stopped the wheel nut coming off. We developed all that with video – who held the replacement wheel, and who pulled off the old wheel.

'So that bit was developing nicely. And then jacks. We tried mechanical jacks and they were pretty dodgy, especially the front jack, so in the end we designed our own air jacks out of titanium and aluminium. We had one at the front and two at the rear, and there was a receptacle at the back of the car. To make it really safe, the guy with the probe that went into the receptacle was at the back of the car. The car stopped with the lollipop man – we invented the lollipop man as well, and the marks on the ground and all that stuff.

'The guy would just run in behind the car and stick the probe in and open the valve. As soon as the car went 'poomph' and stopped, that was the signal for the guys to get the guns on and change the wheels. And as the car popped up, the guys would do the fuel. It was all over in a matter of seconds.

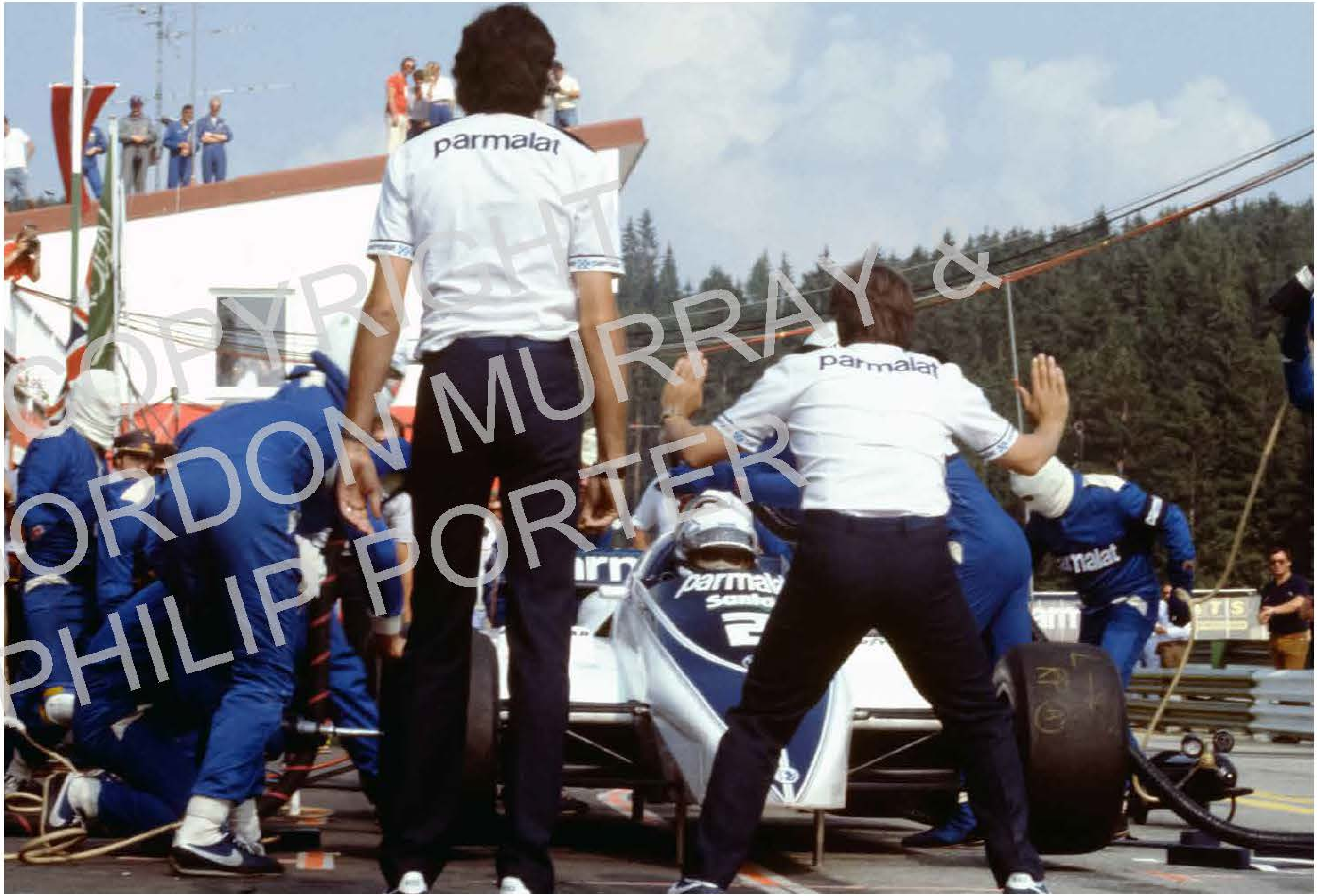
'The final huge problem was the tyres, the cold tyres. Tyre-warmers hadn't been invented then, so we came up with a tyre oven, which was a big plywood box that would take two rears and two fronts on a central pole, and it had a door that you opened to get them out. It had holes drilled in it opposite each tyre so you could put a probe in to see what the temperature was, because you could overcook the compound and it would go off – we did overcook lots of them in testing. Then we had a gas heater that went in at the bottom of the big tube and a chimney on the top.'

All of this work was ostensibly in preparation for the BT51, but it seemed to be offering a clear enough advantage to warrant the creation of the BT50B: 'We actually thought, this is such a good idea, let's try to win some races in '82. We converted BT50s with their full-size tanks into pit-stop cars.

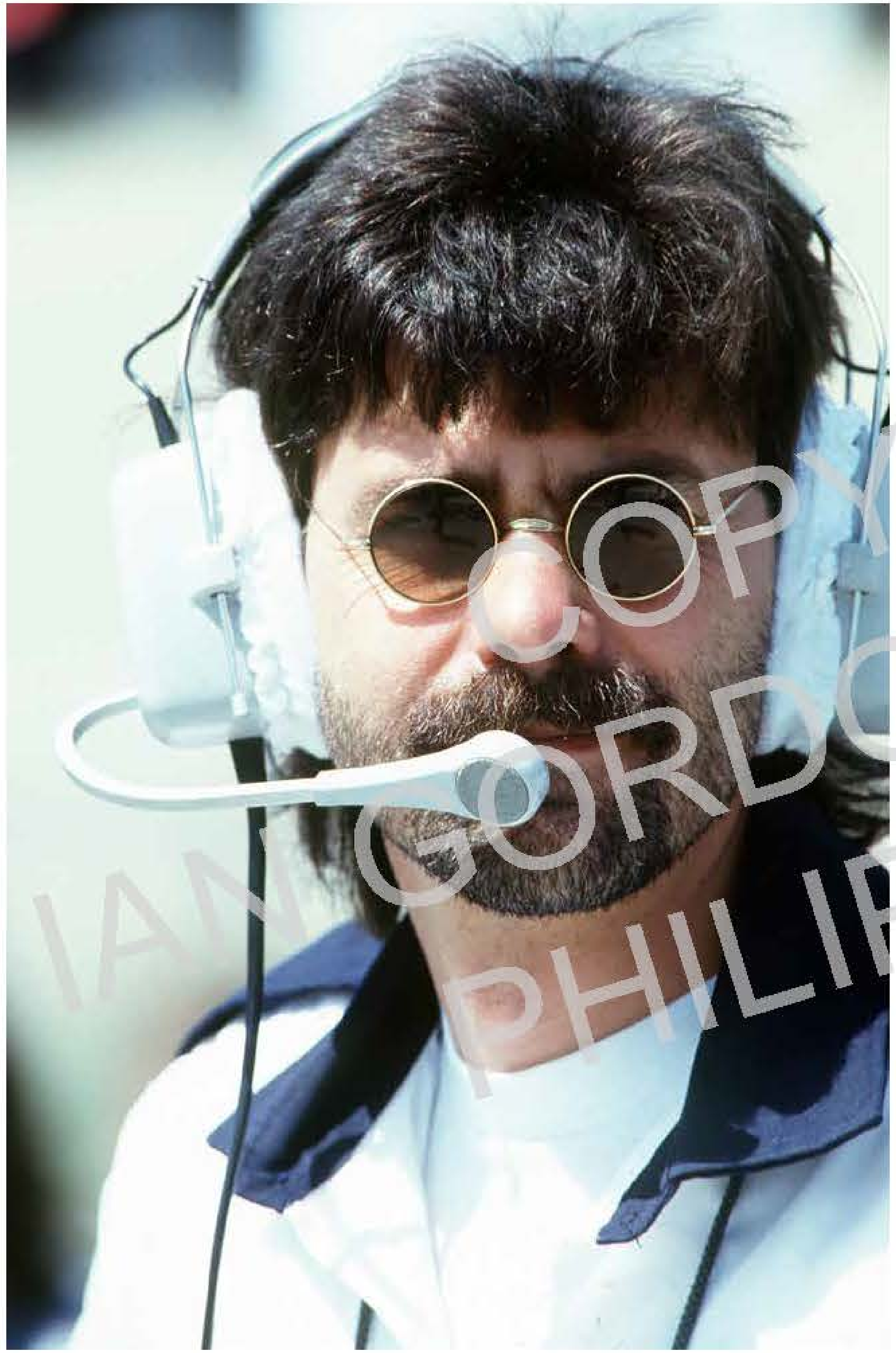
'I think Brands Hatch was the first race where we turned up and people were staring at these beer barrels and these big blue boxes – the ovens. And the special guns and the guys all dressed up in fireproof overalls and stuff like that – then [Team Manager] Herbie and I are standing in front of the car, in shorts and short-sleeved shirts!

'The turbos were so unreliable and the engines were so unreliable, that the only race we got to pit-stop distance was in Austria. That was our first. We couldn't believe we'd finally got an engine to last. It looked like we were going to win the race – and the engine blew up...'

Piquet and Patrese had shared the front row of the grid at the Österreichring, but their double retirement at the picturesque circuit mirrored the results from Brands Hatch, Paul Ricard and Hockenheim. They were fourth and fifth at the Swiss Grand Prix – which, bizarrely, was held in France – but once again neither driver reached the chequered flag in the Italian Grand Prix or the season-closing Caesars Palace Grand Prix. Not surprisingly, at the end of 1982 Brabham languished in seventh position in the Constructors' points.



Right The first pit stop for tyres and fuel with Patrese in the BT50B in Austria. Herbie Blash and Gordon are standing in front of the car, both men in cotton short-sleeved shirts while all the other team members are wearing fireproof overalls!



Right Gordon's image in the BMW years was definitely not what you would call corporate style!

Far right Bernie Ecclestone chats with Gordon. It was a great relationship based on mutual respect

'This was very popular with my guys and they were very unpopular with the other teams because we'd go, `Bye-bye.` And then hopefully win the race the next day.

'We had tried to pit stop with a converted BT50 the year before, and we had failed to finish races. People had laughed at us because the turbos kept blowing up and we rarely made it to half distance. But the cat was out of the bag. I was living on drugs and tablets to stay awake designing this car – I was absolutely knackered. I thought that, because everybody's now seen what we're trying to do, we'll turn up at the first race and everybody will have pit-stop cars.

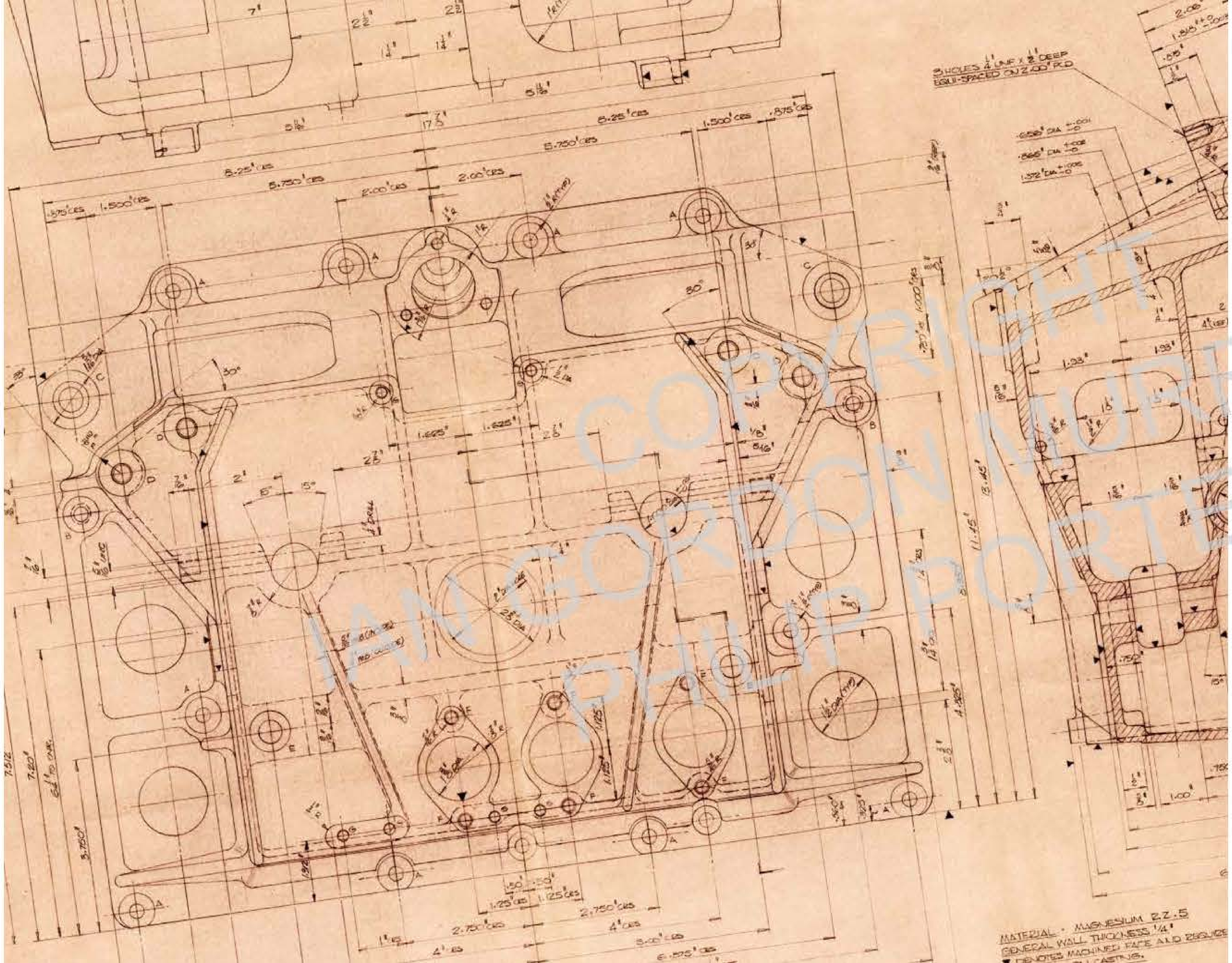
'We turned up at Brazil – nobody did. Williams had a pit-stop kit that they could kind of half-heartedly fit – they had the fillers but they weren't on the car yet. And when they saw us turn up with the car, they fitted their pit-stop kit but then they had a massive fire in the pits and I think that put paid to that. But of course we went on to win the race, and then everybody started trying to catch up and everybody built pit-stop cars very quickly. By then, they'd seen our tyre heaters and our guns, and it was easy to copy because you can't hide all that stuff. And of course everybody then did it.

'We always used to run about two-thirds race distance [before refuelling] and nobody could understand why, because everybody else with pit-stop cars would run half race distance, because then you were the lightest in the first half and the lightest in the second half. But none of them had done the sums. Although it said you have to be this minimum weight throughout the event, they couldn't check the car in the middle of the race. So everybody had to run extra fuel to make sure you were five-10 kilos over the limit at the end of the race because otherwise you'd be disqualified.

'What I used to do was to run two-thirds of the race before the pit stop, and I would run the car so that it was effectively on or just under the weight limit. And then at the pit stop we put in an extra 10 litres of fuel, just to make sure we were over the minimum. So we were running right on the ragged edge, or even underweight, for the first two-thirds of the race. And that's when you'd pull out the lead. People could never, ever work that one out.'

As stated, the BT52, in the hands of Nelson Piquet, won straight out of the box in Brazil, having taken the lead on lap seven. Patrese was less lucky and lasted only 19 laps. Piquet finished second at round three in France, as he did at round five in Monaco. Patrese was having no luck, though he had led for 28 laps of the previous race at Imola before having a slow pit stop when he forgot to keep his foot on the brakes while the car was raised, and then crashed later in the race; Piquet had stalled on the grid.

In Belgium, Piquet was fourth but Patrese's engine did not even last a lap. The Italian also retired from the following race around the streets of Detroit, where Piquet qualified second and finished fourth. Neither Brabham made it to the end of the Canadian Grand Prix, and next up was the British round at Silverstone – for which the BT52 received a series of updates to become the BT52B.


3 HOLES 1/4" UNF x 3/8" DEEP
EQUI-SPACED ON 2.00" PCD
MATERIAL - MAGNESIUM ZZ.5
GENERAL WALL THICKNESS 1/4"
DENOTES MACHINED FACE AND REQUIRE
CASTING.

BRABHAM BT52B

BMW

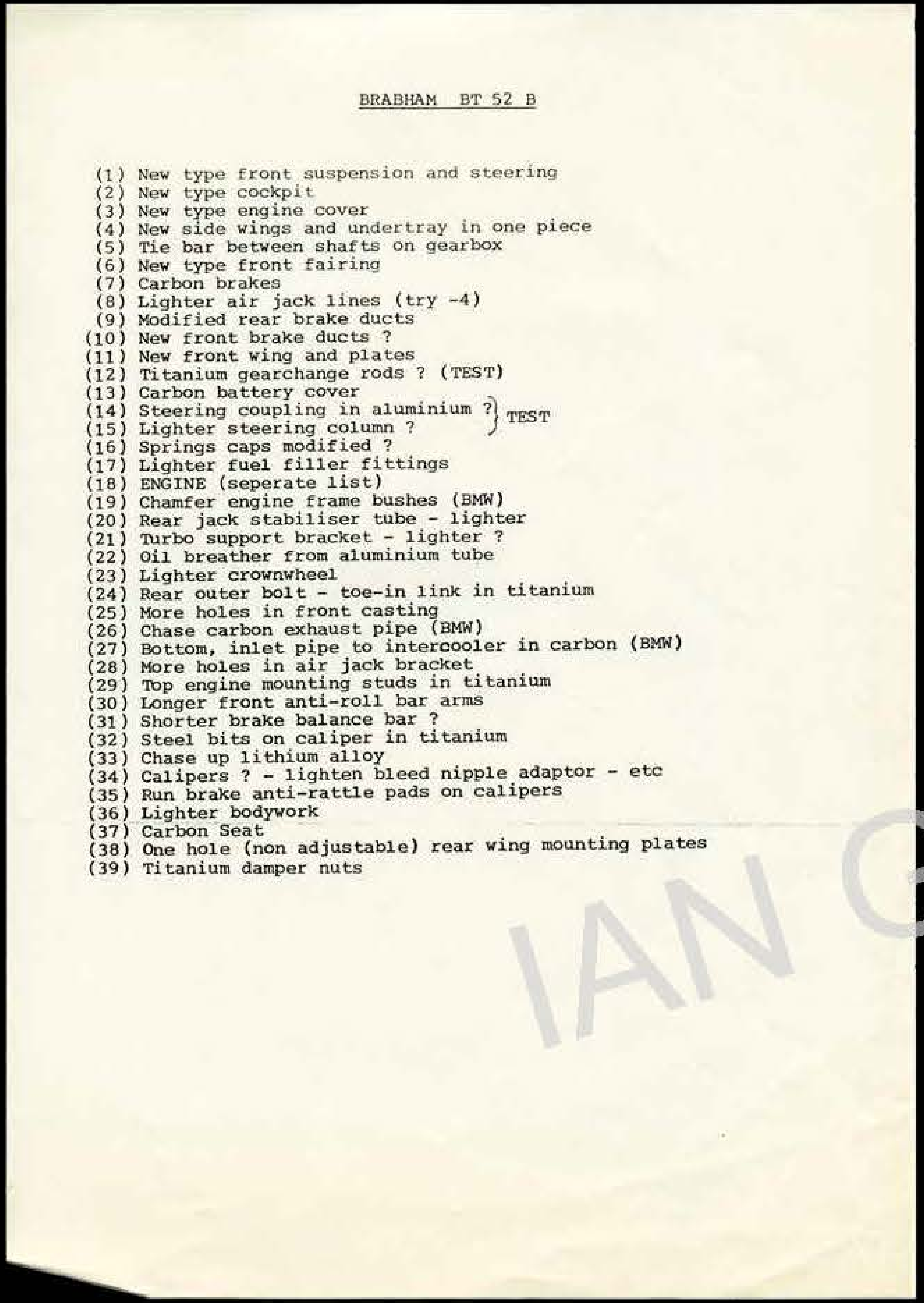
'Paul Rosche was finding more horsepower and more torque all the time. About halfway through the season we were just not getting traction, even out of the medium-speed corners. I was trying everything I could on the chassis and the tyre choice, damping and springs and stuff. But we were traction-limited. Ferrari found a loophole in the regs where you could have winglets on the outside of the wings, in front of the wheel centre line.

'They ran these winglets sticking out in the front of the side plates, which looked pretty ugly. We stepped in mid-season and quickly copied this, and then bolstered the front downforce to balance the car. We made some other body changes and changes to the cooling system. And that became the 52B.'

Other changes included lighter bulkheads, a new underbody form, a smoothing-out of the front suspension blisters on the top of the nose and a greater use of carbon fibre to strengthen the tub. The 52Bs had been used by both drivers from round nine at Silverstone. They actually looked more different from the 52 than they were because Ecclestone swapped the livery from dark blue on top with white below, to white on the body top and dark blue below. This was designed to make the branding of sponsors Parmalat more distinctive: 'Bernie was always great at sorting the car's livery.

'We had a number of engine and turbo failures. The power just kept going up and up and up. We should have easily won the Championship. We should have gone into the last three races easily in the lead, but because of all those failures we needed to win the last three races in order to win the Championship.'

At that stage of the season, Alain Prost in the Renault was seemingly cruising towards his first Drivers' crown. He had 51 points against René Arnoux's 43 and Patrick Tambay's 40. Piquet had just 37. Round 13, of 15, was the Italian Grand Prix at Monza. Patrese led for the first two laps before, inevitably, retiring. Luckily it was Piquet who inherited the lead and won the race. Next came the European Grand Prix at Brands Hatch. This time, Patrese led for the first 10 laps before his team-mate took over and brought his Brabham home first. Two wins out of two, with one to go.



BRABHAM BT 52 B

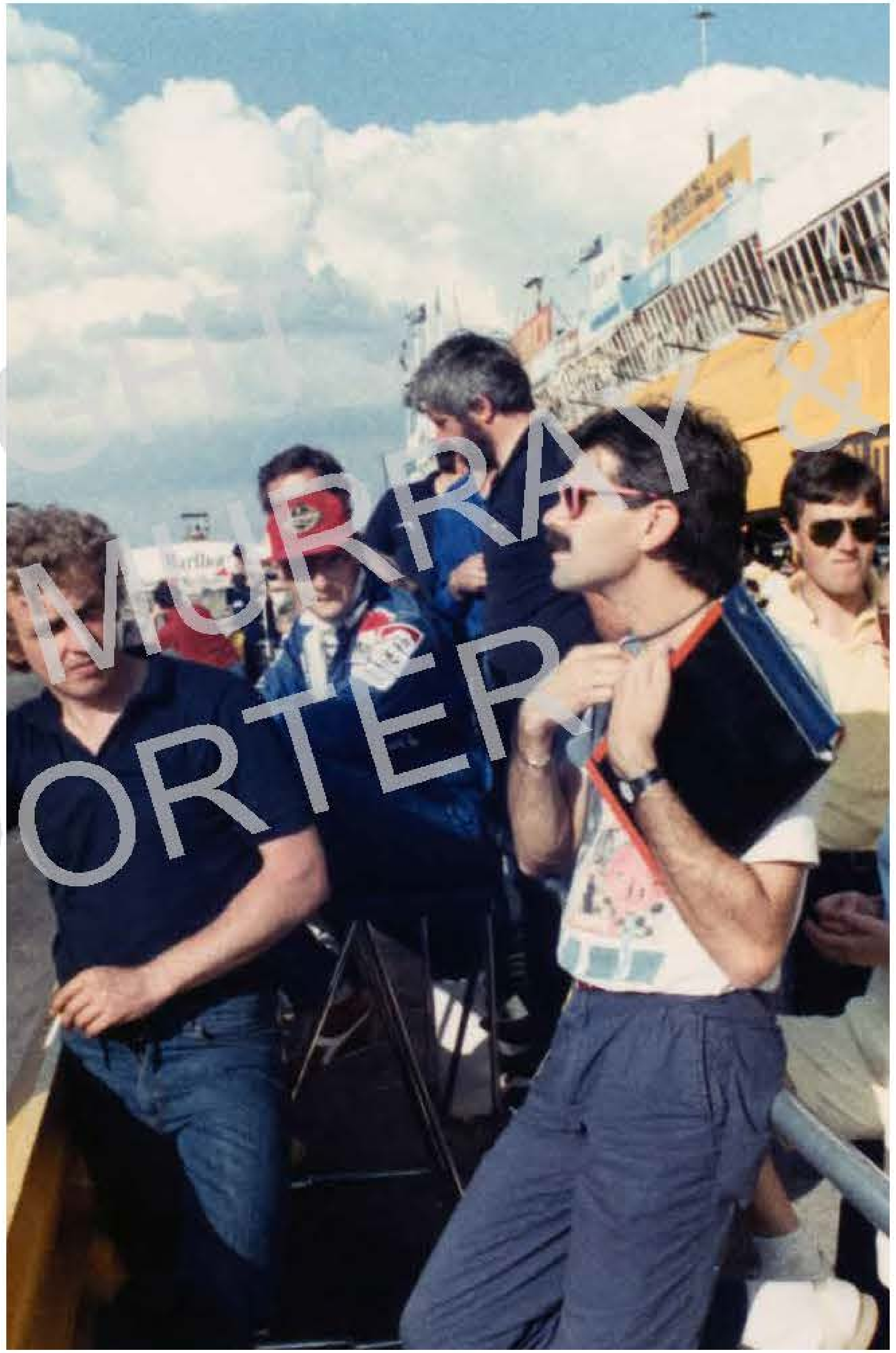
(1) New type front suspension and steering
(2) New type cockpit
(3) New type engine cover
(4) New side wings and undertray in one piece
(5) Tie bar between shafts on gearbox
(6) New type front fairing
(7) Carbon brakes
(8) Lighter air jack lines (try -4)
(9) Modified rear brake ducts
(10) New front brake ducts ?
(11) New front wing and plates
(12) Titanium gearchange rods ? (TEST)
(13) Carbon battery cover
(14) Steering coupling in aluminium ? } TEST
(15) Lighter steering column ?
(16) Springs caps modified ?
(17) Lighter fuel filler fittings
(18) ENGINE (seperate list)
(19) Chamfer engine frame bushes (BMW)
(20) Rear jack stabiliser tube - lighter
(21) Turbo support bracket - lighter ?
(22) Oil breather from aluminium tube
(23) Lighter crownwheel
(24) Rear outer bolt - toe-in link in titanium
(25) More holes in front casting
(26) Chase carbon exhaust pipe (BMW)
(27) Bottom, inlet pipe to intercooler in carbon (BMW)
(28) More holes in air jack bracket
(29) Top engine mounting studs in titanium
(30) Longer front anti-roll bar arms
(31) Shorter brake balance bar ?
(32) Steel bits on caliper in titanium
(33) Chase up lithium alloy
(34) Calipers ? - lighten bleed nipple adaptor - etc
(35) Run brake anti-rattle pads on calipers
(36) Lighter bodywork
(37) Carbon Seat
(38) One hole (non adjustable) rear wing mounting plates
(39) Titanium damper nuts

Above A rare document: a list actually typed up! These are Gordon's changes for the BT52B, with which Piquet won the British GP – its first race

CHARLIE WHITING COMMENTS

'It was an enlightening experience working with Gordon. He was just so easy to talk to and never dismissed ideas, however silly they may have sounded. To be part of the team at that time, and to know that we had such a brilliant designer, was inspiring for us all. I'm sure that Gordon's quiet and laid-back leadership style was the gel that other teams simply didn't have. Who else would have thought of getting the team to do fun warm-up exercises to music in the garage a few hours before the title-deciding race in Kyalami in 1983? All our rivals at Renault in the garage next door could do was shake their heads in despair at how relaxed we looked! Memories such as this will live with me for ever.

'I was lucky to be part of that amazing team where everyone worked hard, played hard and was always made to feel special.'



Left The tussle for the 1983 Drivers' title between Piquet, Arnoux and Prost came down to the last race at Kyalami – Gordon relaxes on the pit wall as McLaren's Niki Lauda looks on

Top Gordon and Piquet talk settings during qualifying. Nelson started from second, with Arnoux's Ferrari third and Prost in the Renault fifth

Above Piquet's pit stop in the final race. He had taken an immediate lead from pole man Patrick Tambay

DAVID NORTH COMMENTS

'It turned out to be a depressing season for us. Nelson Piquet had left for Williams, and his replacement Elio de Angelis died in a tragic accident testing at Ricard. So the atmosphere in the team wasn't as jolly as it had been. The BT55 was a heroic failure. The biggest problem was the engine, which didn't scavenge properly when laid over at 18 degrees. And the offset crankshaft required an unconventional, long gearbox, which again wasn't very reliable. For a variety of reasons, the car wasn't a success. Gordon appeared to lose his motivation and his relationship with Bernie suffered.'

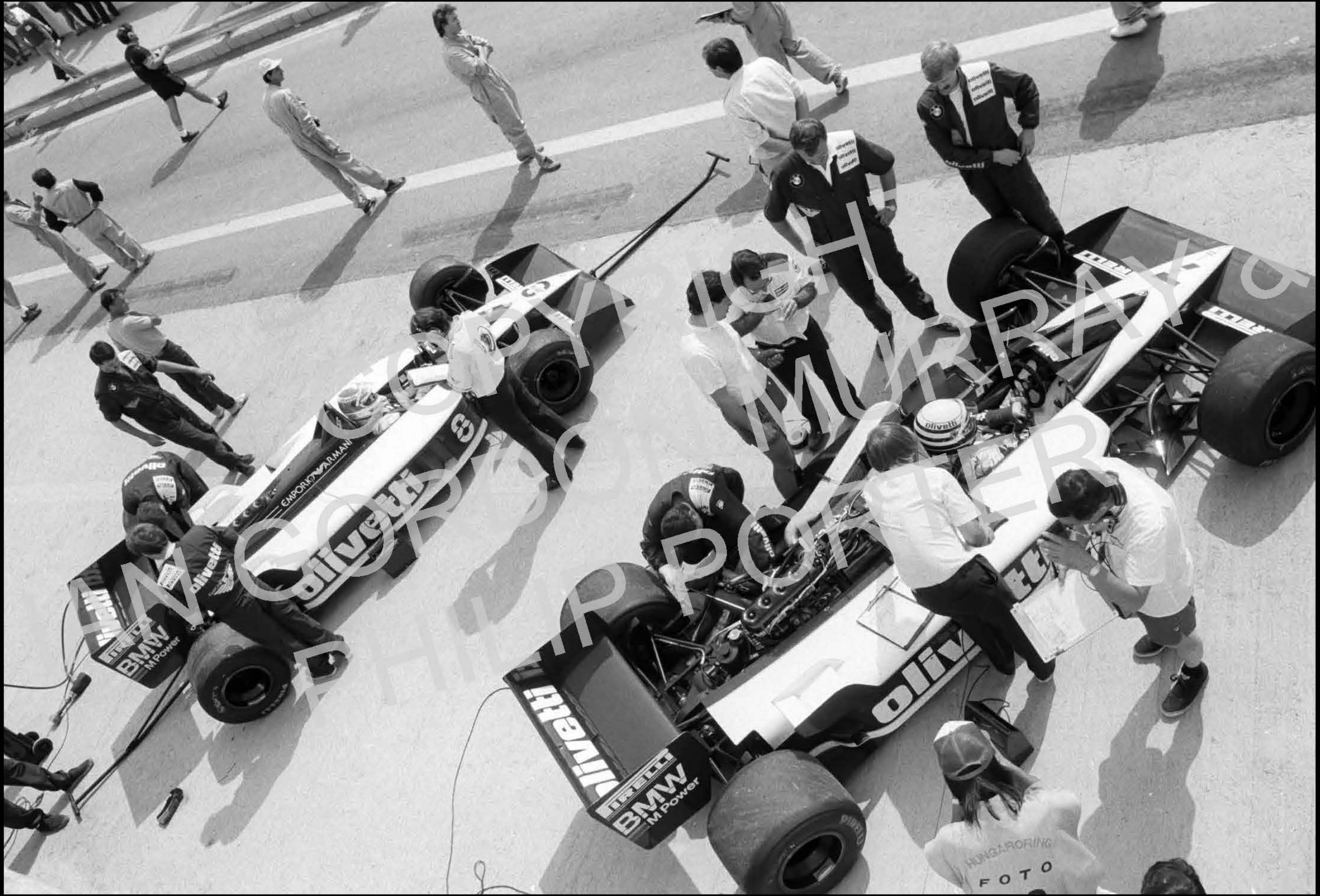
NEIL HARVEY COMMENTS

'I do not believe that Gordon's greatest legacies are the cars he designed and built. I believe it was the quiet leadership he showed to all of us who worked with him and the example he set for understated perfection. He led by example and, regardless of your position, he always treated you with respect and kindness.

'Look at the people who worked with him. Most if not all have gone on to greater positions, all due to his leadership and example of how it should be done. I have owned my own [race car] business for over 25 years and every day I go about my business with what I learned from Gordon.

'At Brabham, we were a complete bunch of misfits. There was Charlie's Angels, the group of mature, more adult-like members, and then there was rest of us that played havoc with the rules of good behaviour. But come race day, we all became a once-in-a-lifetime cohesive group that was led by Gordon.

'We didn't know it at the time, nor did we ever appreciate what he taught us, but years later all of us are indebted to Gordon and his leadership. His cars were pretty awesome as well!'



Right Warwick and Patrese wait in the Hungaroring pit lane. This was the first Hungarian Grand Prix – at the time, the country was still behind the Iron Curtain. Both Brabhams were early retirements

BERNIE ECCLESTONE COMMENTS

When asked why he put the very young, completely inexperienced Gordon Murray in sole charge of the Brabham design department, Bernie Ecclestone says: 'Well, the guy that was in charge told me quite definitely that we ought to have a bit of a change in the department and he suggested that Gordon should be the first to go. So I thought the right thing to do was to keep him!'

It was a bold and brave move but was to work out extremely well: 'As I didn't know what I was talking about with the design of a car, obviously I listened to Gordon. It was no good having an argument with him. So, more or less what Gordon wanted to do, I went along with. I liked to do the livery of the car – how it looked – but it stopped there and Gordon did what he wanted.'

To the suggestion that his respect for Gordon gradually grew, Ecclestone replies: 'Yes, exactly. Absolutely 100 percent. He certainly did a fantastic job for many years.

'It was a good relationship. We never had any problems. I kept out of his way. There was never a situation where I could have an argument with him because the only thing I could have argued about was the way he was dealing with things. As I was happy with the way he was dealing with things, it never happened. We never had that much time to get together personally, just at the race meetings.'

As to where Gordon stands in the pantheon of automotive designers, Bernie states: 'The other guy I'm a big admirer of, and who also did a very good job, was Colin Chapman. And I would put Gordon exactly at Colin's level. And he's still cracking away, which is good.

'Our relationship was very, very good, and also his relationship with all the other people. He worked well with everybody. Everybody realised [how good he was] and had a lot of respect for him, and that was the reason why he got on with people. The only reason you have arguments with people is if you don't respect what they are, what they doing, how they do it.'

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GORDON MURRAY

ONEFORMULA

50 YEARS OF CAR DESIGN

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Philip Porter

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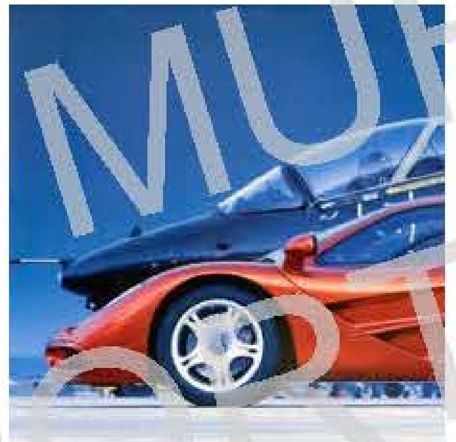

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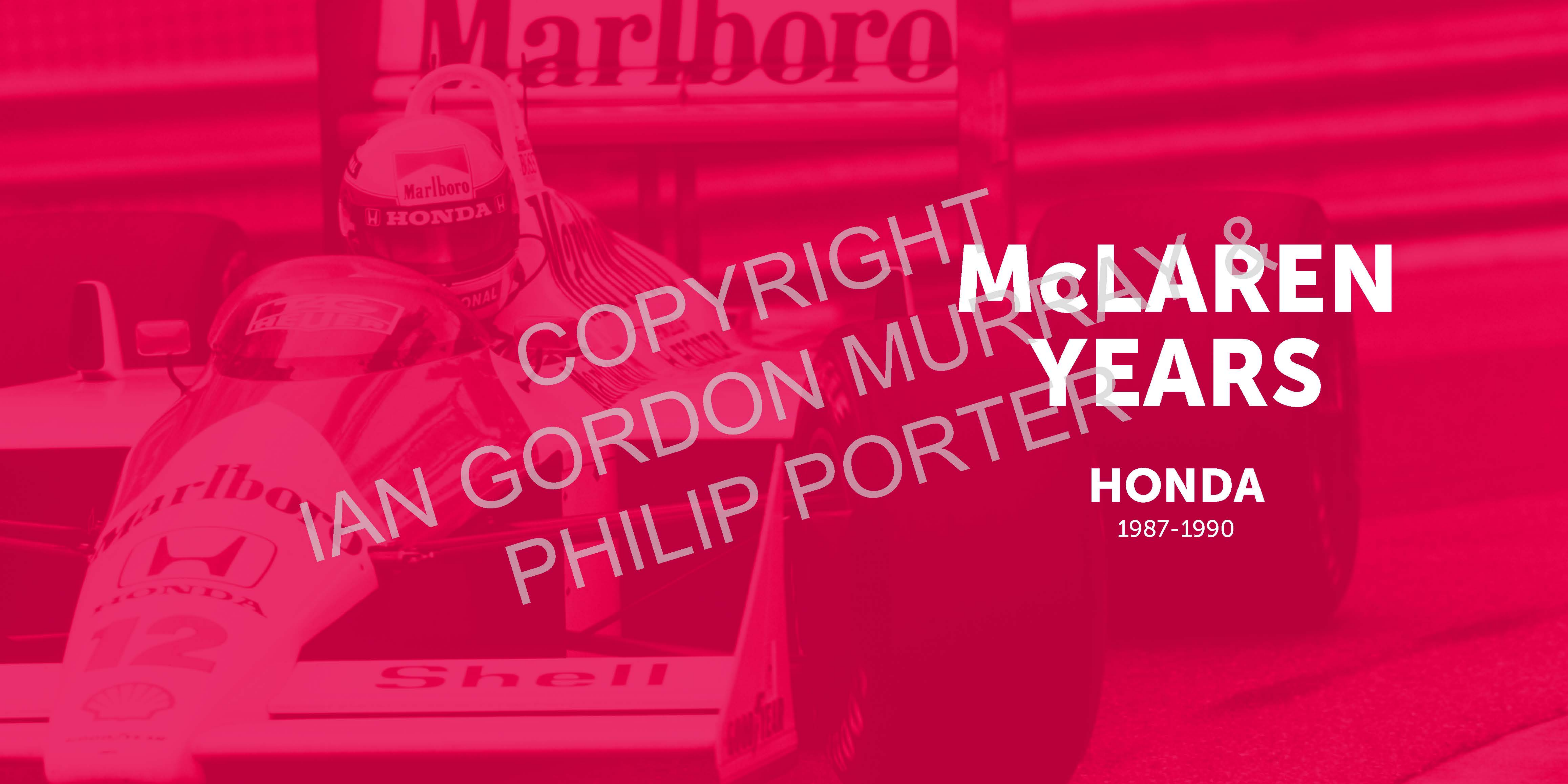
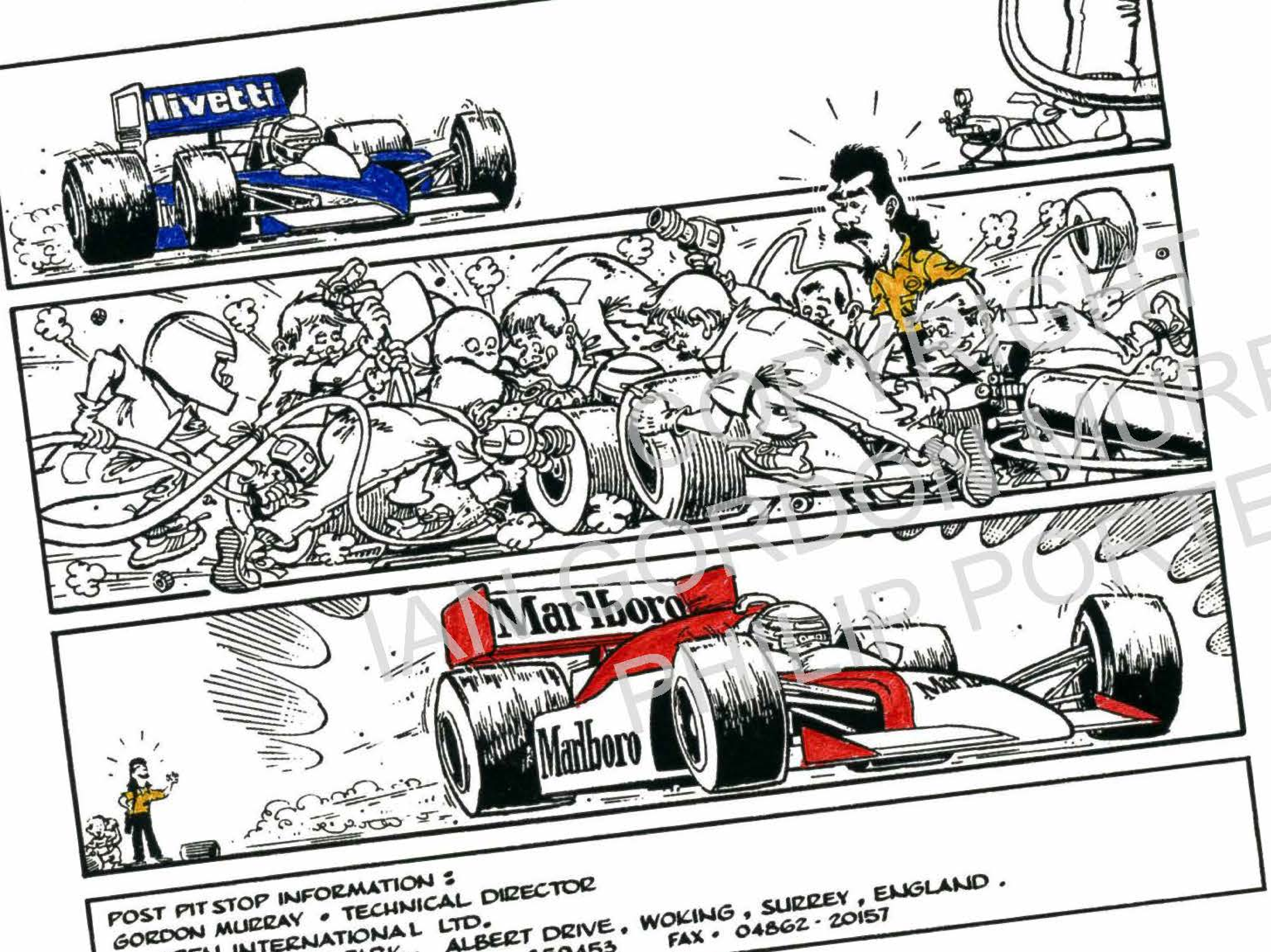


McLAREN YEARS

HONDA

1987-1990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After a decade and a half with Brabham in Formula 1, Gordon felt it was time for a change and fresh challenges. Ron Dennis of McLaren, who had previously tried to entice Gordon to join the team founded by the popular and respected New Zealander Bruce McLaren, succeeded in persuading him to switch camps in 1986. He would be in charge of the technical side for three years before taking on a completely different challenge with McLaren.

'The Brabham years came to an end on rather a sour note because Bernie and I had been partners for 14 years in Formula 1 and, as I've previously mentioned, Bernie's interest in controlling and managing the sport was fast outgrowing his interest in Brabham and we had lost our star driver over a pay dispute. BMW were very disenchanted after we had a disastrous year with the BT55. One of our drivers had had a fatal accident. The tyre contract was coming to an end, the engine contract was coming to an end and it looked pretty bleak.

'To be honest, I'd been in Formula 1 for 17 years and I hadn't lost a driver before, and I was pretty disillusioned. I just felt like doing something else. I'd always wanted to do a road car so I thought I'd probably take a bit of time out and would then come back and start up a little design consultancy, and maybe look at helping other people and eventually do our own cars. It was pretty fluid.

'At the same time as I left Brabham, Ron Dennis and McLaren International, as it was then, had lost John Barnard to Ferrari. Ron was very keen to have somebody take over the design side of the company and the technical leadership. He started courting me about coming over.

'Ron had approached me previously – before he took on Barnard – but I was just in the process of building up Brabham with Nelson Piquet and I was convinced that we were going to win a World Championship. When I looked at the size of our budget and the size of our team, I thought, what a fantastic thing for Bernie and I to do, to take the team, which was completely useless in 1972, and together make it work. He'd given me the freedom of design and running the business, with Herbie Blash, and I don't think we would have been successful if Bernie hadn't stepped back and given us that freedom. He never questioned anything, he never got in the way. So I got used to working like that – as though it was my car and my team. I liked that because I was pretty dictatorial in those days.

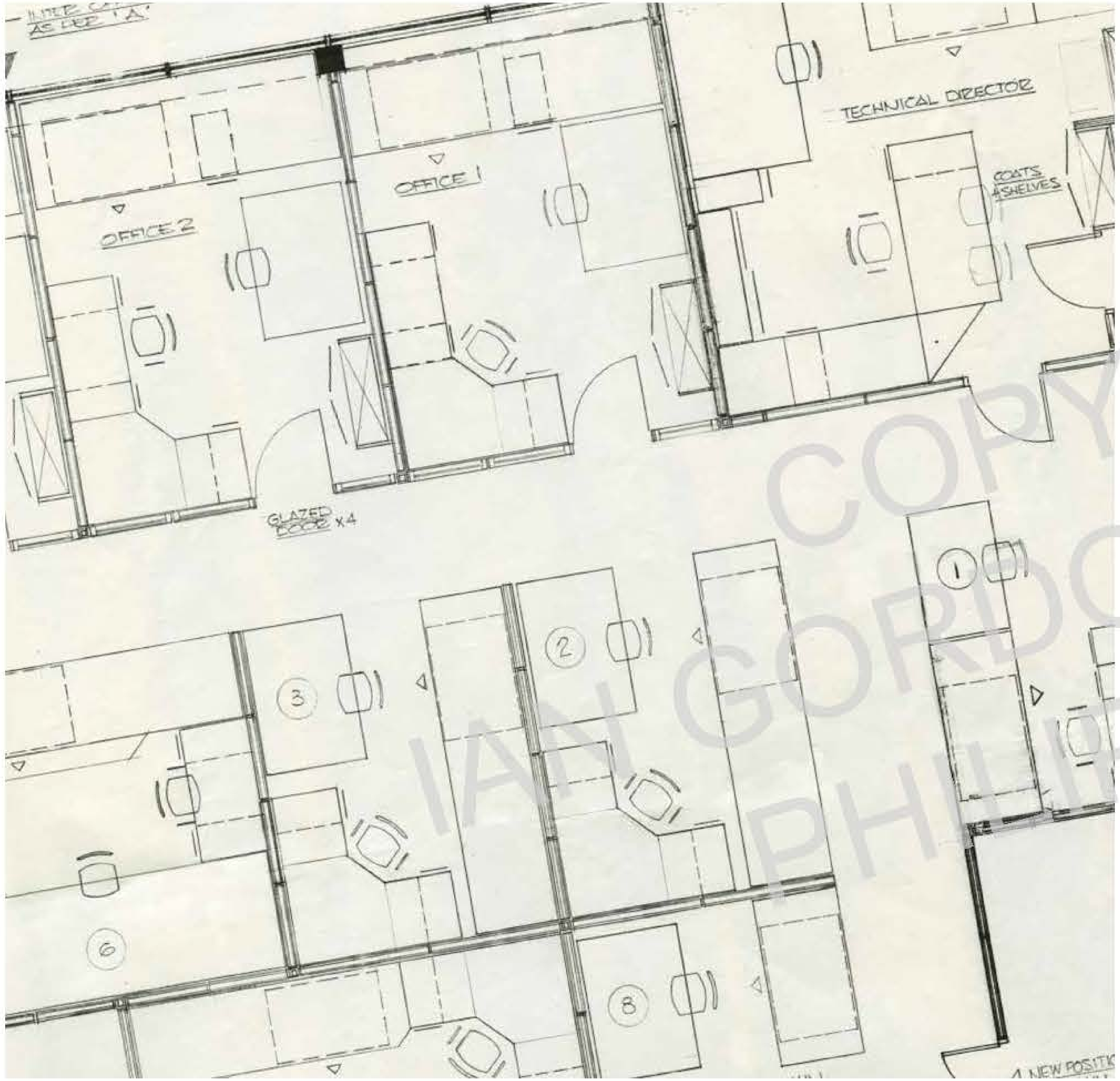
'So I turned Ron down, even though it was a lot of money – much more than I was getting at Brabham. I turned him down because I wanted to be part of building Brabham up with Bernie, and winning Championships, and that's exactly what we did, of course.

'I told Ron, `The reason I've said no is because I've been a massive key part of rebuilding Brabham with Bernie and we're now winning Grands Prix. We've had several cars that have dominated races and I think we could win the Championship next year.` And Ron said, `If you think you're going to win the Championship with Nelson Piquet, forget it.` The very next year we won the Drivers' Championship.'

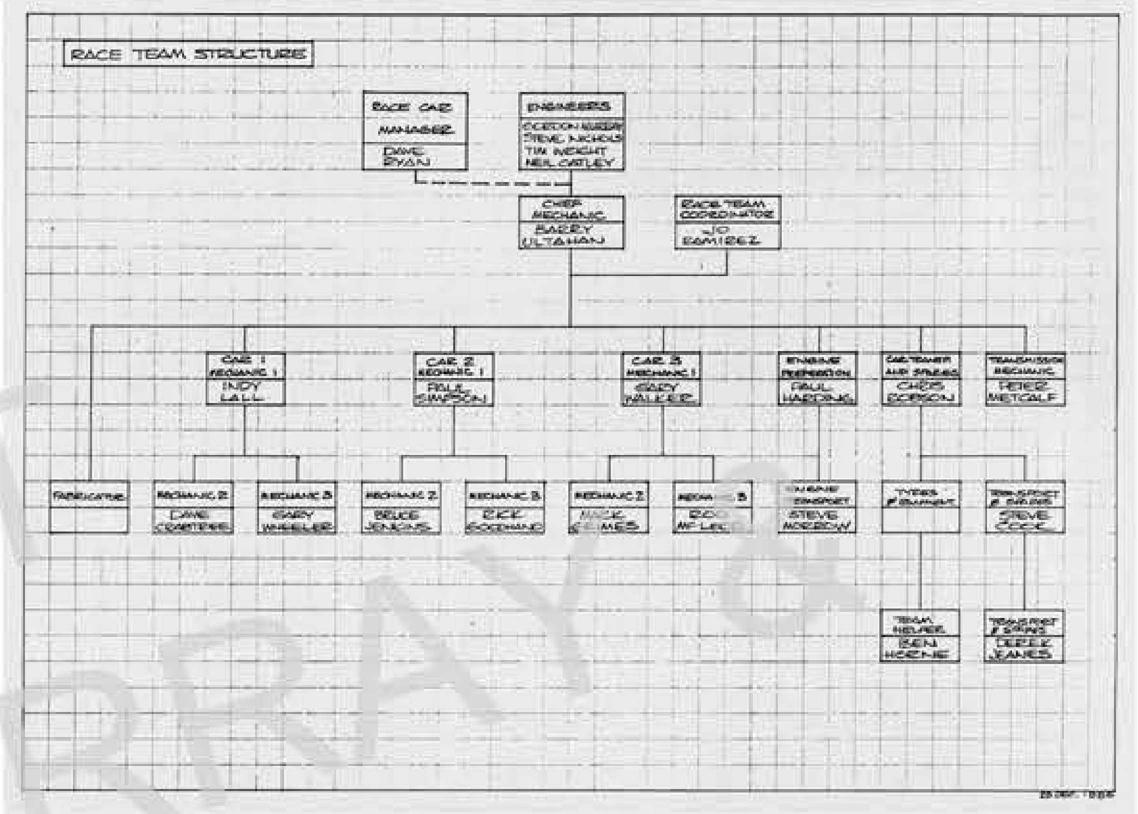
In 1986, when approached again, Gordon told Ron he wouldn't consider it unless he had complete technical control: 'I wanted to become technical director and have total control, not only over the design of the cars, but the whole technical side of the company, because that is what I was used to – making the cars, the testing, the engine, deals, contracts. I wanted to be in charge of everything technical, and that's what he agreed to.

'Ron is very astute. He knew that after John's departure he had nobody on board with the experience to design a completely new Formula 1 car and that was the main reason he offered me the job.

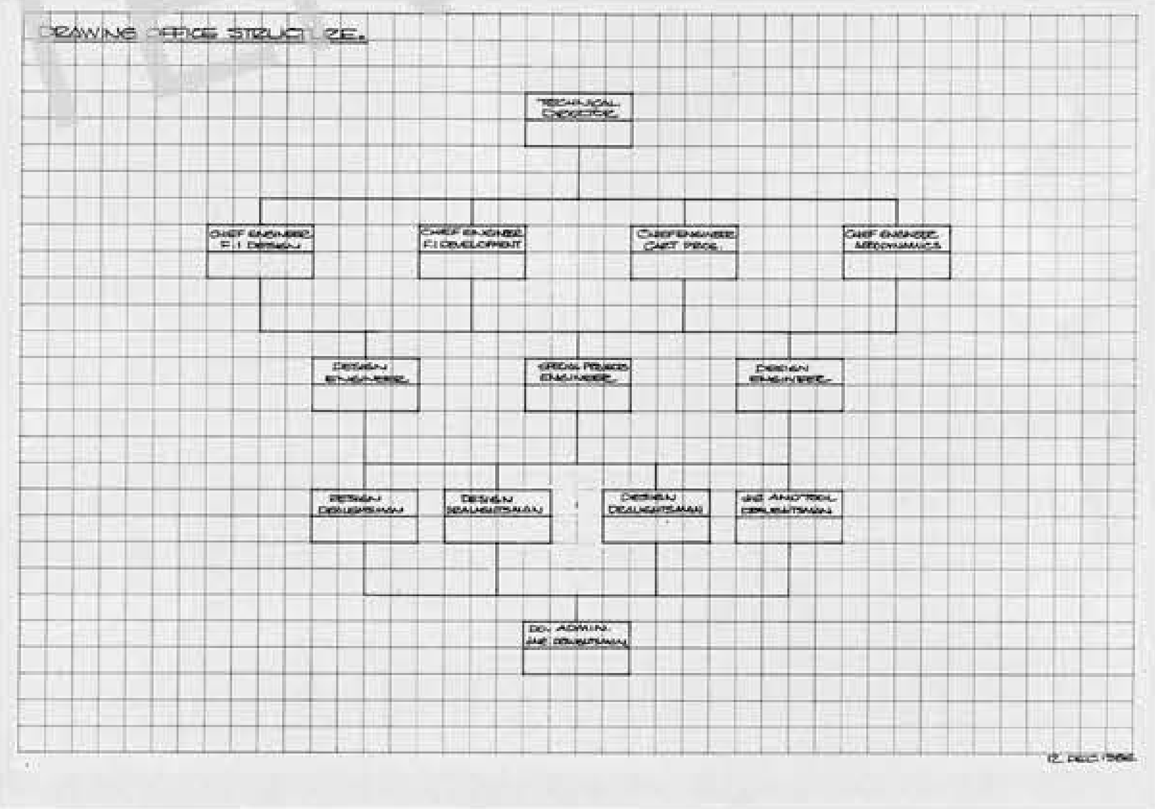
Left Gordon commissioned illustrator Jimmie Hanson to design a card to cover his move from Brabham to McLaren. Ironically, the scene depicted was to come true, with the BT55 layout becoming the basis for the all-conquering McLaren MP4/4



Above Gordon's layout for the redesigned drawing office for a team of fewer than 20, a tiny number by the standards of 30 years hence



Above Gordon's organogram of the race team for the 1987 season. The chart includes some well-known names and makes very clear the hierarchy



Above Similar graphic of Gordon's restructuring of the engineering team when he joined McLaren in 1986 as Technical Director to head up design

'I thought, Christ – that sounds heavy and complicated. We'd only got a few months before the first race, but there was nothing else we could do. I had started semi-dry-sumping gearboxes on the BT44 in 1974 by just collecting the oil under acceleration to the back of the car, trapping it there and then filtering it and pumping it back to the gears in the final drive. But nobody had ever done what I would call a 100 percent dry-sump gearbox, where you would take all the oil out of the gearbox so the gearbox is dry and then you pump it back specifically to just the gears. I was always a bit frightened to do that because when you've got no oil splashing around – or very little – if you don't get it put back right first time, you're going to get some gears running dry, breaking teeth or exploding.

'We were looking at this and Weismann said, `You've got a set of gears right up the front of the gearbox, sitting there anyway. Why don't we put a casing over those and make them an oil pump and pick up oil from the front of the gearbox?` It was our little problem. Everybody only had a pump at the back. So, when you were braking, the oil that was left in the gearbox was still sloshing around and all the gears were losing oil. Whereas with an engine you have – at the very least – a scavenge pump at the front, a scavenge pump at the back and usually a couple in the middle as well. So you're taking all the oil out of the engine, all the time, and it's dry. And you just pump it back through the bearings.

I'M SURE THE CARS CAME FROM THIS DIRECTION IN 1957...
CHRIST! SO THIS IS WHAT IT'S LIKE TO BE TALL...
I WISH I'D PAID MORE FOR THESE SHADES I CAN'T SEE A BLOODY THING...
BLIMEY! LESS RIGHT UP TO HER ARSE!!
THAT'S 3 MISSED GEARS THIS LAP... HE CAN CHANGE THE BLEEDIN' DOGS HIMSELF

Above Gordon tries his hand as a cartoonist, lampooning the race team!

'But with a gearbox it's not quite that easy because it's not just the bearings you want oil on but the gears as they engage. So you have little spray bars. On top of doing a brand-new three-shaft gearbox in a few months, we were going to a complete dry-sump gearbox. I really debated that in my head and I thought, Pete – I know you're a genius, but maybe that's a step too far and, if we don't get it right, it's going to lose us races. And of course Ron was pissed off that I was using Weismann.

'To cut a long story short, that's exactly what we did. We covered the front gear set, picked up oil at the front and picked up oil at the rear. I made my usual test rig for gearboxes, which I had brought from Brabham to McLaren. Tipped up the gearbox, tested it and it seemed to work absolutely fine. Got it all done and the car was finished just in time to do one day of testing at Imola before the 1988 season. We went down to that test and it was one and a half seconds a lap quicker than anybody, just as I'd hoped the Brabham BT55 would have been.

'Hats off to Weismann and David, that car was so reliable. It won 15 out of 16 races. And the only race we lost at Monza was because Prost had an electrode fall off a spark plug. It's never happened in all my years of racing; I've never had a mechanical spark plug failure. And Senna was over-exuberant, as he always was, passing back-markers and tripped over the Williams of Jean-Louis Schlesser as he was lapping him at the first chicane and crashed out of the race. That was the only race we lost. So that would have been 16 out of 16.

'The MP4/4 has gone down in history as the most winning car, but when you analyse it, it was radical but it wasn't radical. It was radical because it had the Brabham lay-down, very low, style, which was much lower than any other car on the grid. The centre of gravity helped a little bit but mainly it was the aerodynamics. So that was radical. But the car itself – the chassis, the suspension – nothing trick on it at all. It had the old Brabham rod-operated suspension, carbon brakes, typical McLaren very simple monocoque, very simple aerodynamics, no trick front wing, no trick rear wing – just a very straightforward, very simple motor car.

'So that bit just wasn't radical at all. The radical bits were the lay-down driving position and the transmission. And the transmission was a necessity. It wasn't like, `Oh, how can we beat the opposition? Let's do a dry-sump gearbox. That'll get us another three horsepower.` It wasn't that at all. It was pure necessity. If you look at that motor car, it was really, really straightforward.

'The lay-down architecture, and the resulting aerodynamic advantage, were the things that made the car win. And not forgetting the systems that were in place because, without those, we wouldn't have finished 15 out of 16 races anyway. We had all those systems. By then, I'd had a year in the team. I had all the debriefing after the race and analysing failures.

'When I first got to McLaren, I said to the guys, `Can I have the failure sheet from 1986, please?` They said, `What do you mean?` and I said, `The list of everything that's failed on the cars, whether in private testing, practice, qualifying, the race.` They said, `Oh no, we don't have that.`

'So then I had to go back and speak to people about tests and the races, and they would say, `Yes, we cracked two lower wishbones at this race, the brakes failed at this one.` And I came up with 78 failures during that season. Not all of them were major, and not all of them stopped the car, but some things happened after the race, such as the final drive exploding on the last lap in 1986.

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Above Gordon with Honda's Osamu Goto. He developed a very good technical relationship with Goto-san and the two men still collaborate on projects today

NEIL OATLEY COMMENTS

'Goto was actually the chief engineer and technical manager for the Honda race engine projects, similar to a technical director role in racing. Each engine then had its own chief designer: V6 was Kawamoto, V10 was Abe, V12 was Kawamoto. This was not the same Kawamoto who was president of Honda at the time.'

McLAREN YEARS

THE ROAD CARS

1992-1994

1992

McLAREN F1 T.22 SPECIFICATIONS

MILESTONE VEHICLE

Weight	1,110kg
Engine	BMW 6.1-litre V12
Chassis numbers	01-074

Design notes

First all-carbon road car

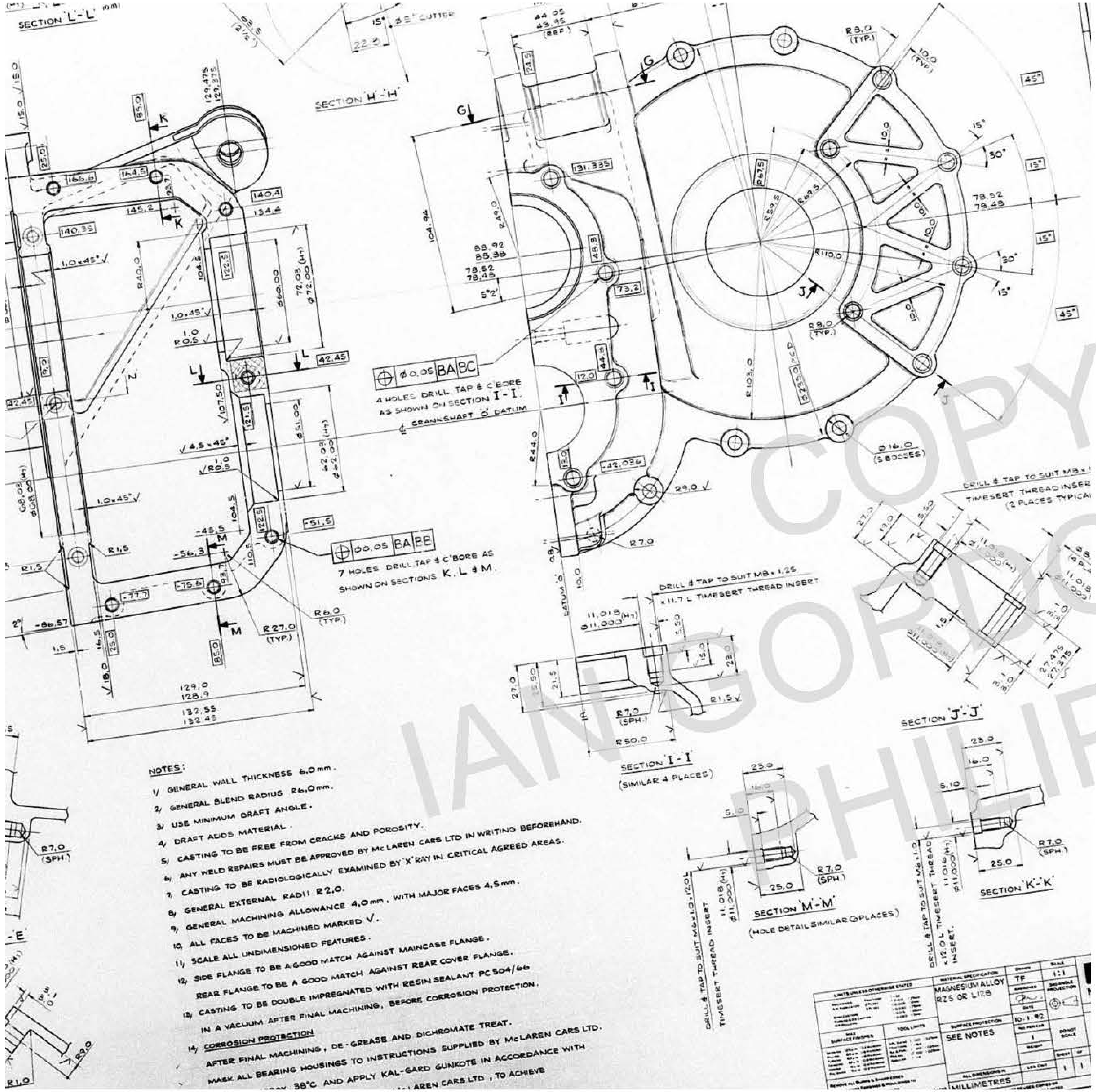
Top-speed record for road cars: 240.1mph

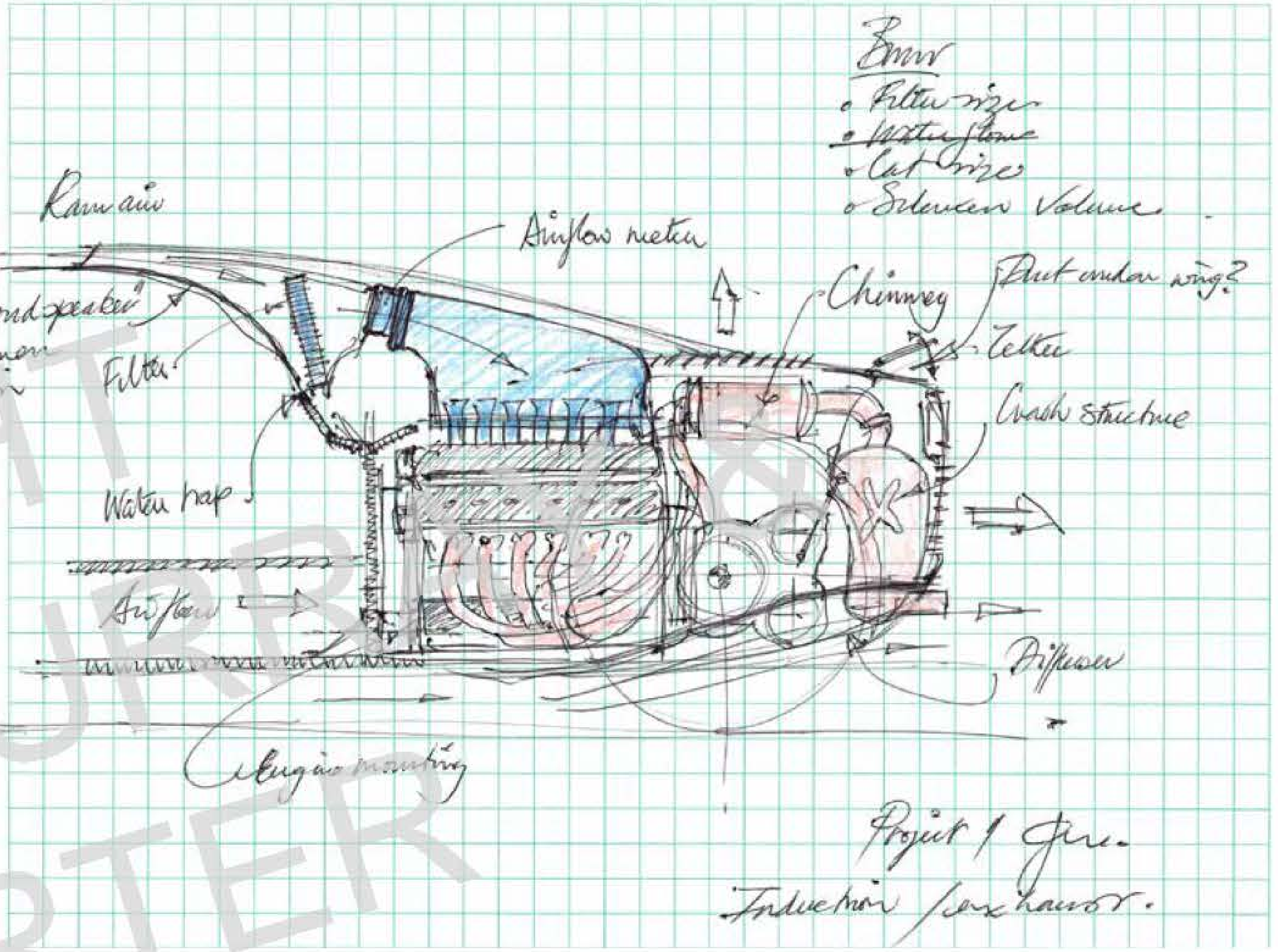
First road car to have active aero

First ground-effect road car

First road car to use carbon clutch

First road car to have active brake cooling


SECTION 'L'-'L'
SECTION 'H'-'H'
SECTION 'I'-'I'
(SIMILAR 4 PLACES)
SECTION 'J'-'J'
SECTION 'M'-'M'
(HOLE DETAIL SIMILAR @ PLACES)
SECTION 'K'-'K'
4 HOLES DRILL, TAP & C'BORE AS SHOWN ON SECTION I-I.
7 HOLES DRILL, TAP & C'BORE AS SHOWN ON SECTIONS K, L & M.
DRILL & TAP TO SUIT M8 x 1.25 x 11.7 L TIMESERT THREAD INSERT
MAGNESIUM ALLOY RZ5 OR L128
SEE NOTES
MILLIMETRES
NOTES:
1/ GENERAL WALL THICKNESS 6,0 mm.
2/ GENERAL BLEND RADIUS R6,0 mm.
3/ USE MINIMUM DRAFT ANGLE.
4/ DRAFT ADDS MATERIAL.
5/ CASTING TO BE FREE FROM CRACKS AND POROSITY.
6/ ANY WELD REPAIRS MUST BE APPROVED BY Mc LAREN CARS LTD IN WRITING BEFOREHAND.
7/ CASTING TO BE RADIOLOGICALLY EXAMINED BY 'X' RAY IN CRITICAL AGREED AREAS.
8/ GENERAL EXTERNAL RADII R2,0.
9/ GENERAL MACHINING ALLOWANCE 4,0 mm, WITH MAJOR FACES 4,5 mm.
10/ ALL FACES TO BE MACHINED MARKED √.
11/ SCALE ALL UNDIMENSIONED FEATURES.
12/ SIDE FLANGE TO BE A GOOD MATCH AGAINST MAINCASE FLANGE.
REAR FLANGE TO BE A GOOD MATCH AGAINST REAR COVER FLANGE.
13/ CASTING TO BE DOUBLE IMPREGNATED WITH RESIN SEALANT PC 504/66
IN A VACUUM AFTER FINAL MACHINING, BEFORE CORROSION PROTECTION.
14/ CORROSION PROTECTION
AFTER FINAL MACHINING, DE-GREASE AND DICHROMATE TREAT.
MASK ALL BEARING HOUSINGS TO INSTRUCTIONS SUPPLIED BY McLAREN CARS LTD.
38°C AND APPLY KAL-GARD GUNKOTE IN ACCORDANCE WITH
McLAREN CARS LTD, TO ACHIEVE



'To make it light we designed absolutely everything. We did our own gearbox, we did our own instruments, our own handbrake, our own steering column, our own steering rack. Nothing was proprietary on it apart from a few little switches. Everything was hand-made.

'I was fanatical about weight, and the stories about that abound. With two thicknesses of washer, we needed a 7mm bolt for the clutch pedal. There wasn't a 7mm bolt made, only 6mm. The stress calculations said 6mm wasn't big enough and 8mm was too big, so we made a 7mm one. I made people draw a 7mm bolt and nut because that's all it needed. There are plenty of light-hearted stories.

'I was slowly but surely hiring people in areas of expertise in which I was weak – like body engineering, door seals and latches, overslam, upholstery and stuff like that. That's not my forté. My road cars had been very basic up until then. So I hired, for example, Barry Lett, who was a body engineer. Barry taught me about body engineering and I taught Barry about suspension and stuff like that. We all had to multi-task. I had one particularly bright young guy called Steve Randle, who did all the stress analysis – simply because I didn't have time. Steve also had some good input into the suspension.

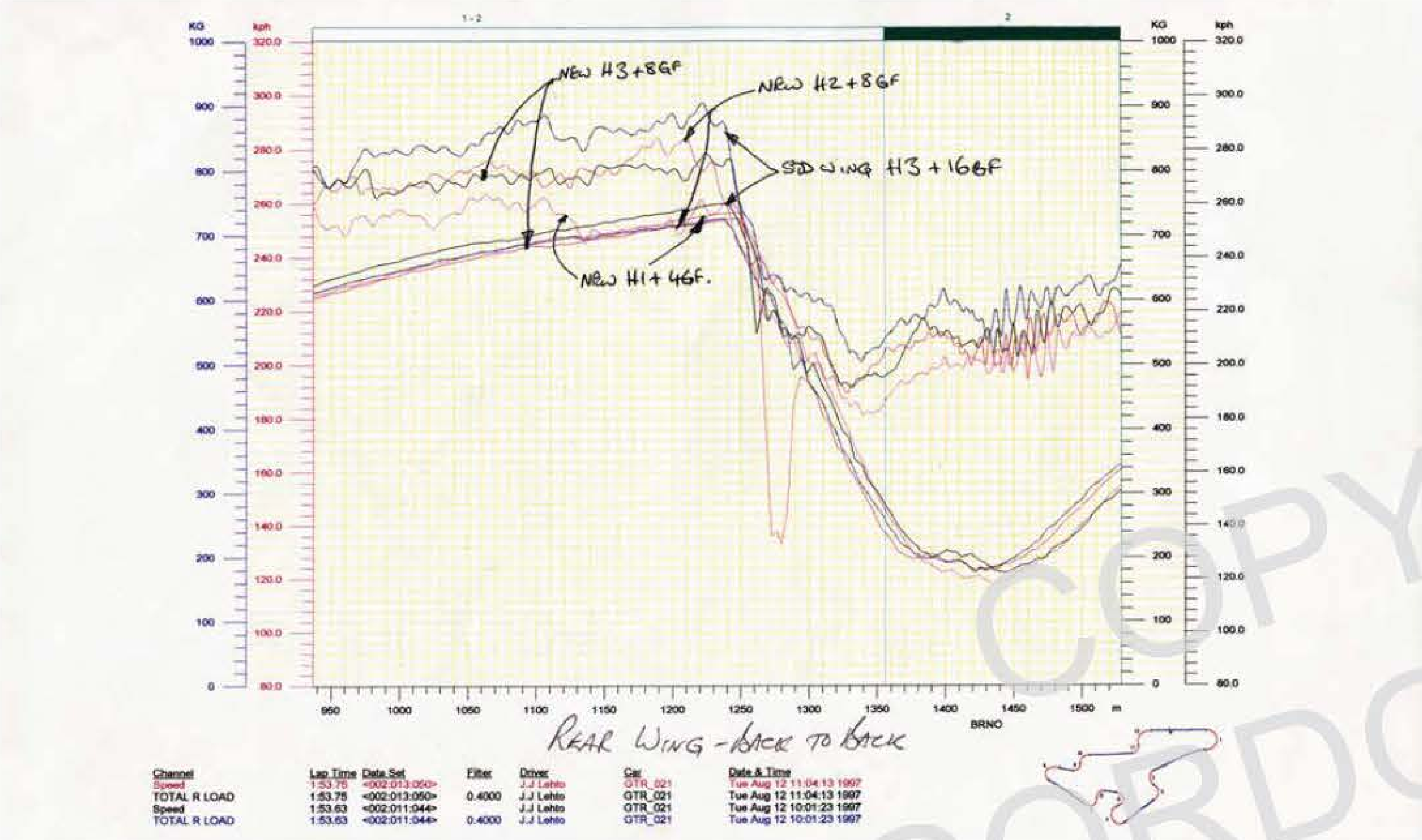
'I wanted somebody to do all the design for the composites and the monocoque. I couldn't do everything. I interviewed all sorts of people for that job and I eventually found this guy called Paul Martin, who was the first person that sat in front of me that knew more about composites than me. All the others were just useless, really. So I hired Paul and he was very good at doing all the design and stress work for the monocoque, and how many layers we needed, and lay-ups and so on.

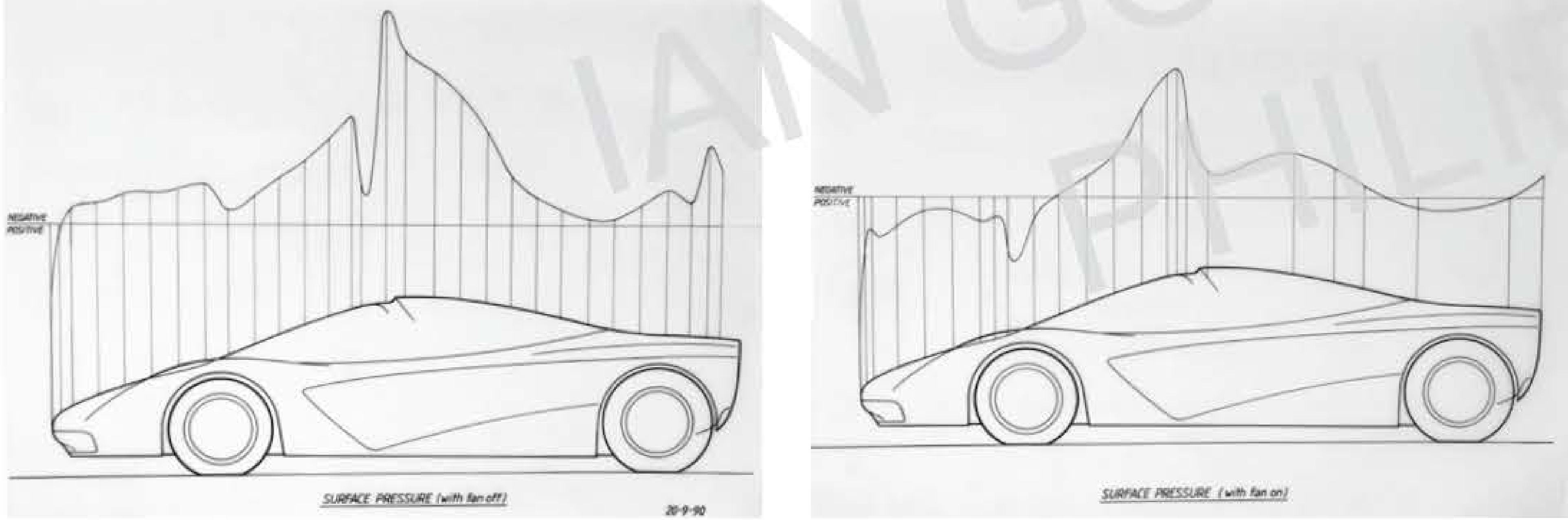
'I didn't want a stylist because I knew in my head what the size and the proportions of the car were going to be. And even the ethos. I had these things I'd written down about the car. I'd done some sketches. The car should be very smooth, with classic lines. Good proportions – very uncluttered. Then, as it got to the back, like a Formula 1 car there should be – and there would have to be – lots of chimneys and exits to let all the air out. With 600 horsepower in, basically, a sealed box, you have to get the air in and out.

'I had in my head that the car would be very *mechanical* when you got to the rear, to the point where maybe the whole back end was open. So, when you were behind it, there were just exhausts and you could see through to the suspension. I was going to have the springs red or yellow or something.

Above Early sketches of the engine-bay package, heat management and gearchange mechanism

Left The transmission was designed in-house. The Pete Weismann/Gordon Murray concept was drawn almost entirely by Tim Feast in 12 months. The pencil drawings were a work of art




NEGATIVE
POSITIVE
SURFACE PRESSURE (with fan off)
20-9-90
NEGATIVE
POSITIVE
SURFACE PRESSURE (with fan on)

Above The aerodynamic development work was a combination of track testing and wind tunnel. Track testing different configurations is shown at the top, while above are two diagrams illustrating the performance advantage of the fan-assisted ground effect

'With those two facts in mind, I thought, 'Right, what about a different way of heating the screen?' Then the air-con unit could be much smaller, much lighter and much more compact. Most of the energy in an air-con unit is to de-ice six millimetres of ice in something like 10 minutes, from a cold start. That's where all the fan and the heating element comes from with air-con. If I could heat the screen another way, A) the air-con we design would be just for the people, so you could get warm quicker, and B) it would be small enough to go in the nose and I would get my low scuttle.

'I read about the Saint Gobain glass company, which had electrically heated screens in jet fighters. These consisted of a plasma-sprayed metal between two layers of glass, but it needed 58 volts to drive it. TAG were our partners for doing the electronics. I went to TAG and said, 'Can you make us a DC/DC converter that will change 12 to 58 volts?' And they said, 'Yes, we can. It's expensive but we can.'

'Then I flew over to Saint Gobain with Creighton and I said, 'I want to use your technology in a car.' They said, 'Pfff, that's going to take two or three years to develop for a car. Fighters are generally this shape of screen and cars have got different requirements, and ice and this and that.'

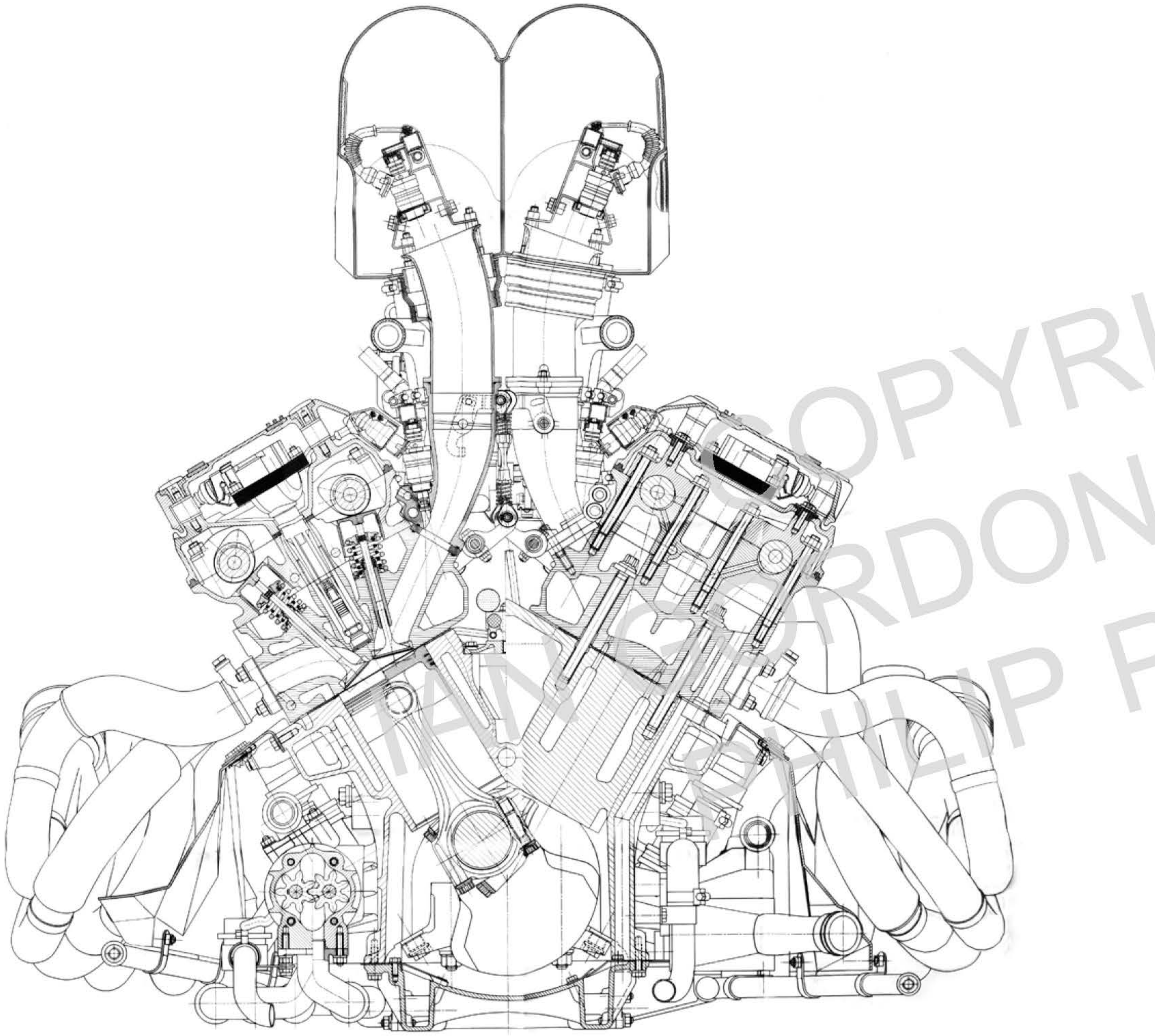
'I said, 'Why would it take that long?' So they sat down and explained why it would take that long. I said, 'If I give you one engineer, I think we can do it in under a year.' They said, 'OK.' And they did, and every F1 out there has got zoned, plasma-sprayed, 58-volt heating.

'It needed too much power to switch it on all on at once, so if you look very closely at an F1 screen there are two faint lines either side of the driver where the two plasma sheets of metal are joined. And there are discreet wires to three zones – the driver one clears in about 10 seconds, then that switches off and clears the other two, then they switch off and it clears the side glass.

Above left Gordon in the Teddington Formula 1 wind tunnel

Left An early F1 block model in the wind tunnel

'THE McLAREN F1 WAS AN INCREDIBLY FOCUSED PROJECT. I HAD A FANATICAL APPROACH TO LIGHTWEIGHTING AND DETAIL DESIGN'



As previously mentioned, Gordon was thinking about marketing angles all the way through the design process. Many aspects were, if you like, intended to be pure theatre as well as pure engineering.

'I was always thinking about the experience, not just the performance. And what would make this car special. We had to pass the Swiss drive-by regulation for noise, which I think was only 74 decibels, and with a supercar the tyres are two-thirds of the noise, so you haven't got much to play with for the exhaust. It was obvious that you were sitting a long way in front of the exhaust and it would therefore sound quiet to the driver, so the excitement in the car, noise-wise, would be lacking. You had this beautiful engine but it wasn't going to be that loud.

'My idea was: forget the exhaust noise, let's make the induction noise exciting. And it doesn't affect the drive-by noise very much at all – it's only the people in the cabin. Right from the beginning, I wanted a spine down the middle of the car. If you look at an F1, there's a duct in the bonnet that, if you look through the glass, turns into the instrument cowl and then you've got the top-entry engine inlet, which was one of my design features I had from day one. Then the spine runs down and separates the two rear glass panels. It runs right through the car. That was always intentional. And the top inlet is – it's Formula 1 – it's a high airbox and it just runs straight into the inlet valves.

'So the induction was over your head. I tuned the piece of carbon where the induction pulses are coming forwards and backwards up through that. I tuned the thickness of that so it's a loudspeaker. When owners came in to talk about the car and sit in the seating buck, I explained this to them. And when we had running cars it was easy because I could take them out and show them this roar inside an F1, which everybody thinks is exhaust. But it's nothing to do with the exhaust. It's this *loudspeaker*. Because that's all a loudspeaker is: just a membrane moving the air. And it transfers the noise perfectly through this thin thing. I offered everybody a thin one and a thick one. Nobody bought the thick one. We never made one.

'On every F1, all that lovely induction growl that everybody writes about is nothing to do with the exhaust noise at all.'

In order to save weight, there aren't any passenger seats. The monocoque is the right shape for the passenger seat and they're just a thin fibreglass moulding that the trim is attached to: 'It just clips into the monocoque, so the passenger seats are completely immoveable and part of the chassis. I wanted these to blend in. Whatever colour people picked for the under-trim door cards, that matched the passenger seat.

'With the driver's seat, I tried to encourage every owner to pick the body colour, or a contrasting colour, and have the central band of the driver's seat in that colour. My idea was that when the car was parked and a little kid came along and peered in, it would look like a single-seater and you couldn't see the passenger seats. It works!

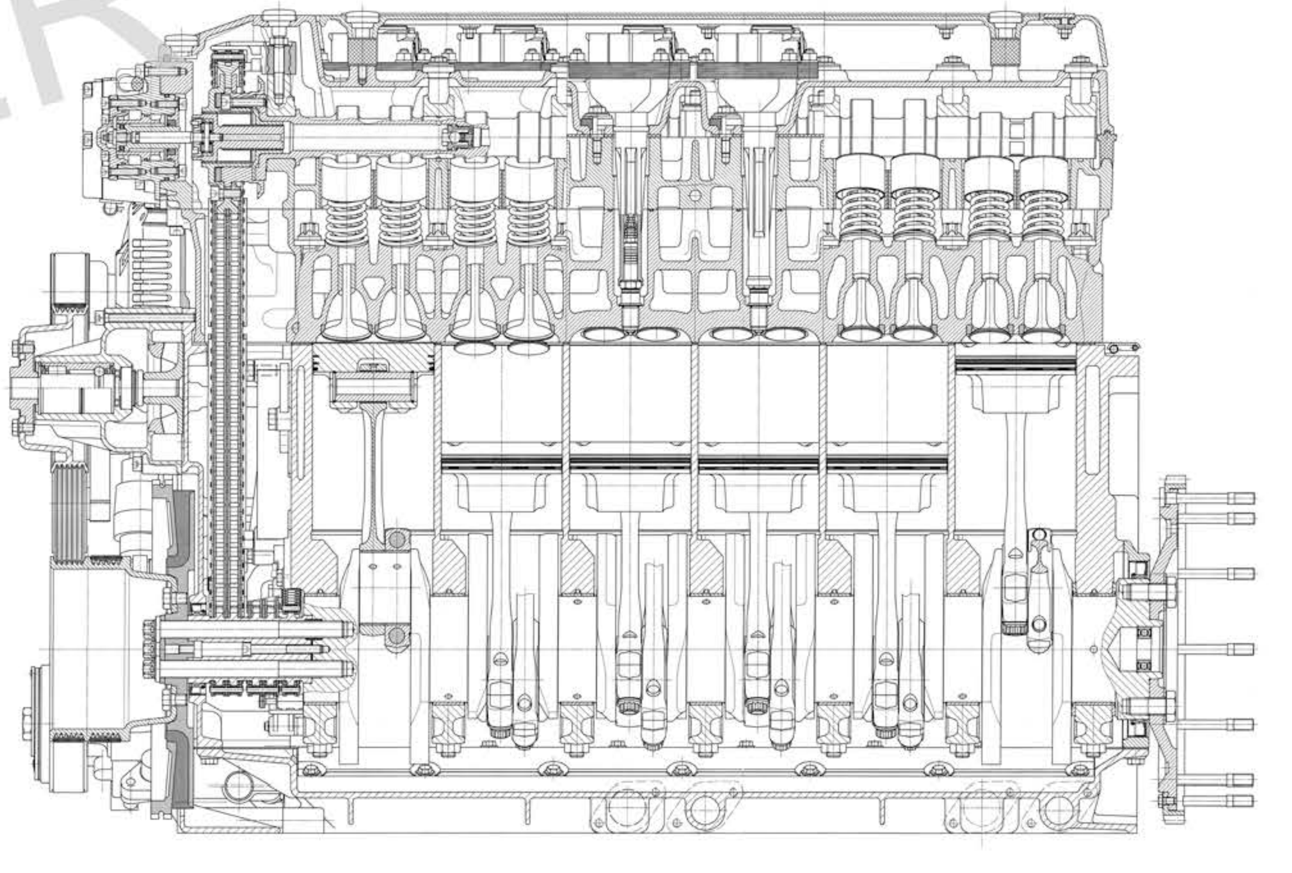
'Nearly every owner took my advice and did the coloured middle seat. To take that further, I designed luggage for the car and it had a little Alcantara strap under the handle, with the chassis number embossed. That strip is the same colour as the central seat band and the car. I tried to do matching stuff like that all the way through.

'Another part of the F1 design that I really focused on, and wanted to be special and different and right, was the driver position and the ergonomics, the primary controls and the secondary controls. First of all, anything the driver could see or touch, I wanted to be ultra-special. So much has been written about the F1 pedals, the machined pedals and the machined-aluminium knobs, instead of plastic and stuff like that. The feel of the gear lever was very important to me. I physically drew every part and I checked it myself because it was such an important part. I drew not just the concept but every part of the mechanism because I wanted the parts to be absolutely beautiful.

'My steer for the team was, "Let's really focus on the things the driver can touch and feel, but I don't want anything on the car, even though it's hidden and may never be seen, that's clunky or bad engineering." So even stuff like windscreen-wiper brackets, which you will probably only see as a replacement part, are milled from solid aluminium and are beautiful pieces of engineering. Every single thing on the car is like that.

'I tried really hard with the ergonomics. First of all, you're sitting in the middle, which is a good start, but secondly the driver got a fantastic feel for being in a jet fighter, as I always called it. So the instruments would be very clear and very easy to read. Barry Lett did a great job on the seat shape, too – they're so comfortable, with just 20mm of foam.

'The primary controls that are used all the time, and which I wanted the driver to be able to reach, are on two pods next to the wheel. Things you need in an instant are the horn or the flasher. On most cars, the flasher is on the end of a stalk and the horn is in the middle of the wheel, so I had two paddles that you operate with your index finger without moving your hands. One is the horn and one is the headlight. If you want to get somebody out of the way on the autobahn, you can hit those both very quickly.



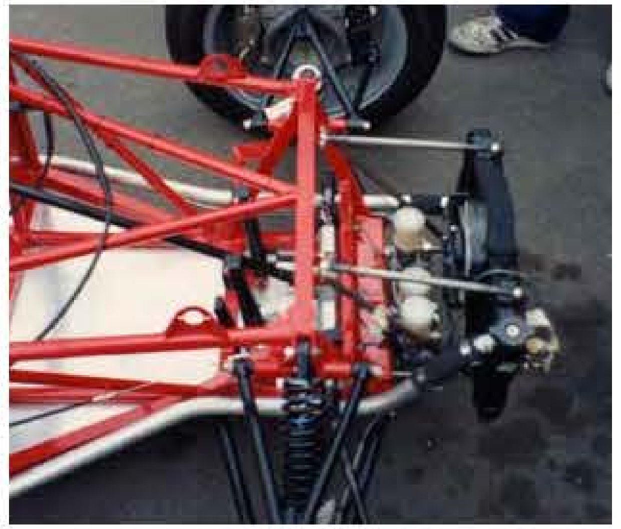
Above The S70/2 V12 – spec by Gordon, design by Paul Rosche and built by BMW M-Sport

Left The power unit that Rosche designed for the F1 programme was an extremely compact 60-degree V12

Above Chris Craft tries the prototype chassis for size

Above Bob Curl's pattern before mould-making

Above Early mock-up with chassis 01 to check the ergonomics

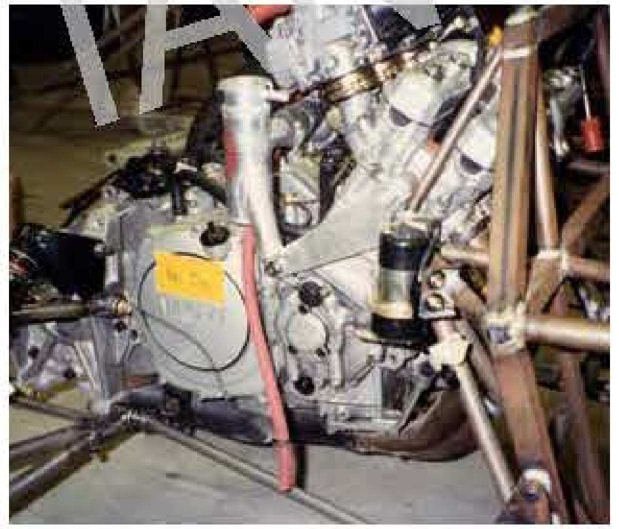


Above Ultra lightweight – the bare chassis weighs just 21kg

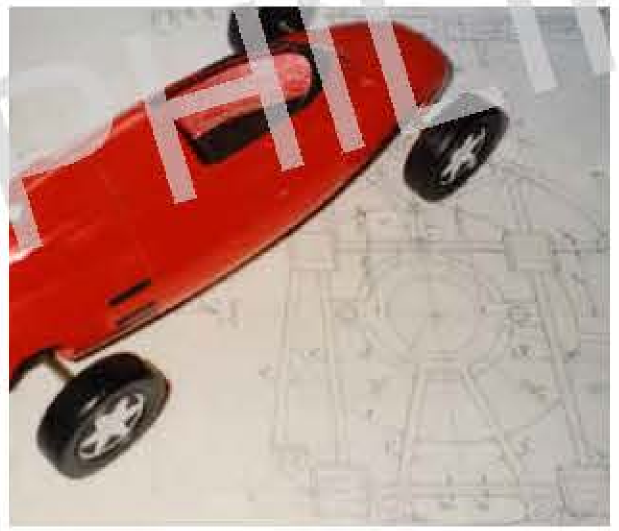
Above Chris Craft tries the rear body moulding on 01

Above In charge of prototype build – Tony Mundy with 01

Above Pete Weismann's compact and light transmission



Above The Yamaha FZR powerplant is a stressed member, as in a Formula 1 car



Above A 1:8 scale model was built to check the styling proportions

The motivation for doing the long hours and overcoming all the technical hurdles was quite simply the challenge. It was certainly never financial.

'Why it turned out to be so expensive as a motor car, and way ahead of its time for a track-day car, was just the fact that everything was bespoke – everything. We cast our own uprights, made our own gun-drilled driveshafts, brakes and other stuff. Everything was bespoke.

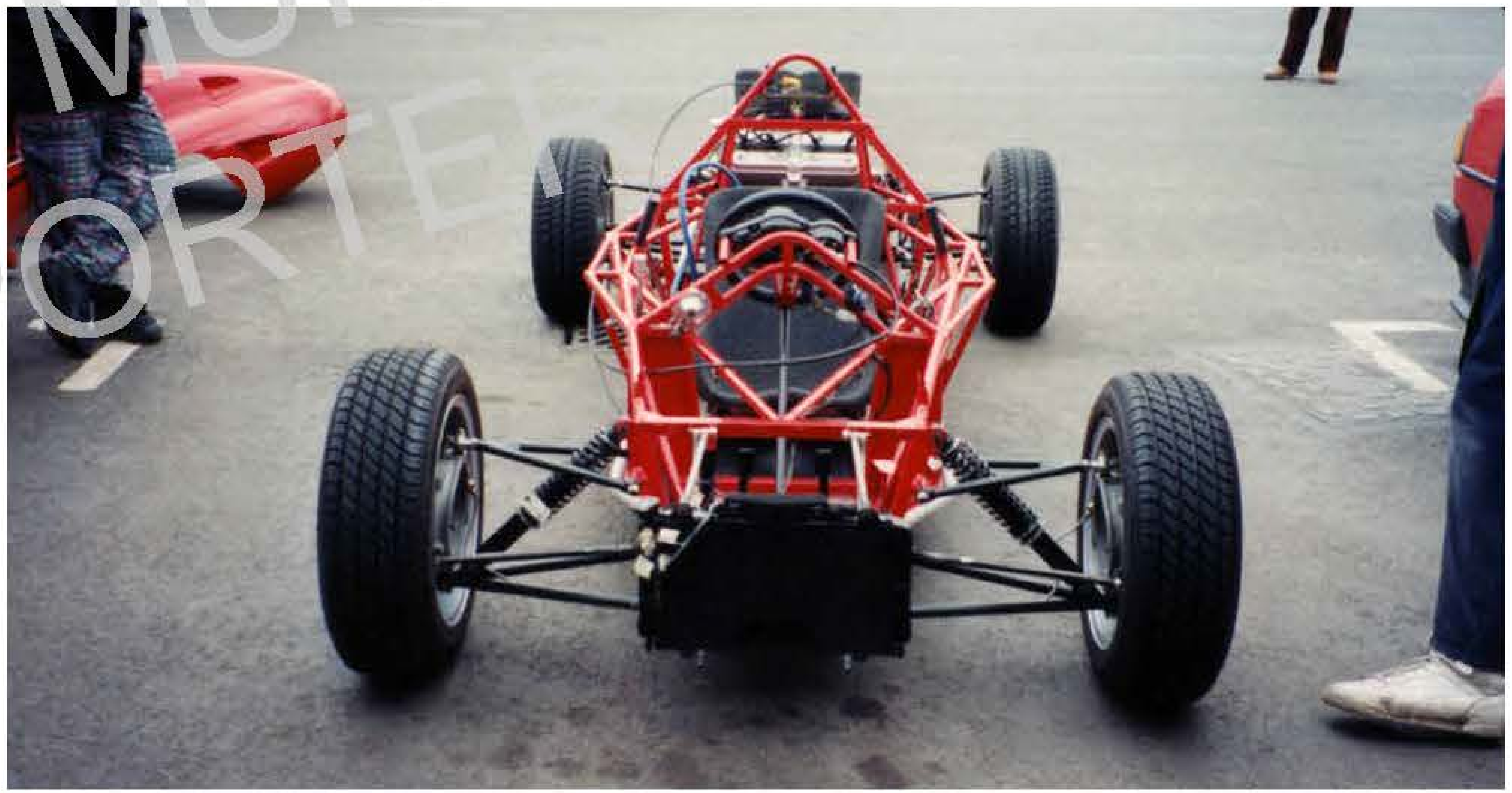
'But the end result is, still, the lightest road car in the world, and still something that if anybody wants a demonstration of what light weight can do – low polar moment inertia – just jump in the Rocket and drive it because there's no substitute in design and engineering for light weight in the car. It just helps you 100 percent of the time.

'On the design side, I was fanatical about the weight. I've never used rear anti-roll bars on a car. I hate them because you go to all this trouble of making cars with an independent rear suspension then you connect the left- and right-hand axles together with an anti-roll bar, which seems stupid when you try and put the power down through those wheels. I started that trend in Formula 1, by losing the rear anti-roll bars. And on this one, I didn't even want a front anti-roll bar – that was to save two kilos. My theory was quite simple. It was that the car was so light, and the centre of gravity was so low, that the roll couple would be quite small anyway. So it didn't need a lot to stop it from rolling.

'I managed to get the roll axis – which is the axis the car rolls around – a little bit higher than you would normally have done if you had a front anti-roll bar. As soon as the car rolls, the roll axis moves up, so actually it counters the roll. And then the final bit of reasoning was, if you're sitting in the middle of the car, you don't actually perceive much roll. If you're sitting right out on one side of the car and it lifts or dives, you can feel that movement, like a boat. If you're sitting in the middle around the roll axis, you're just tipping. And actually it all works because if you look at a picture of a Rocket on a race-track, cornering fast, it has quite a few degrees of roll on the chassis, but you just don't feel it.

'So that was one way I saved weight. I also tried really hard on the wheel and tyre size. I didn't want to over-wheel and tyre it because I wanted it to be a fun car to drift, particularly on a track, to drift and slide around. Unfortunately, for that top speed – because the Rocket does about 145mph – the smallest tyres that Michelin could give me were actually bigger than the car needed. I worked very closely with Michelin and all my usual suppliers: Showa on the dampers, Michelin, Brembo on the brakes, OZ on the wheels. All the people that had helped me in Formula 1 came in and helped us on the Rocket. The rear tyres aren't bad, but the front tyres should have been a little bit narrower.

'The tyre size was actually for a Peugeot 205 GTi, so the compound was much too hard for the Rocket. But ultimately it's much more fun because the car starts drifting and sliding at much lower speeds, so it turned out OK in the end.

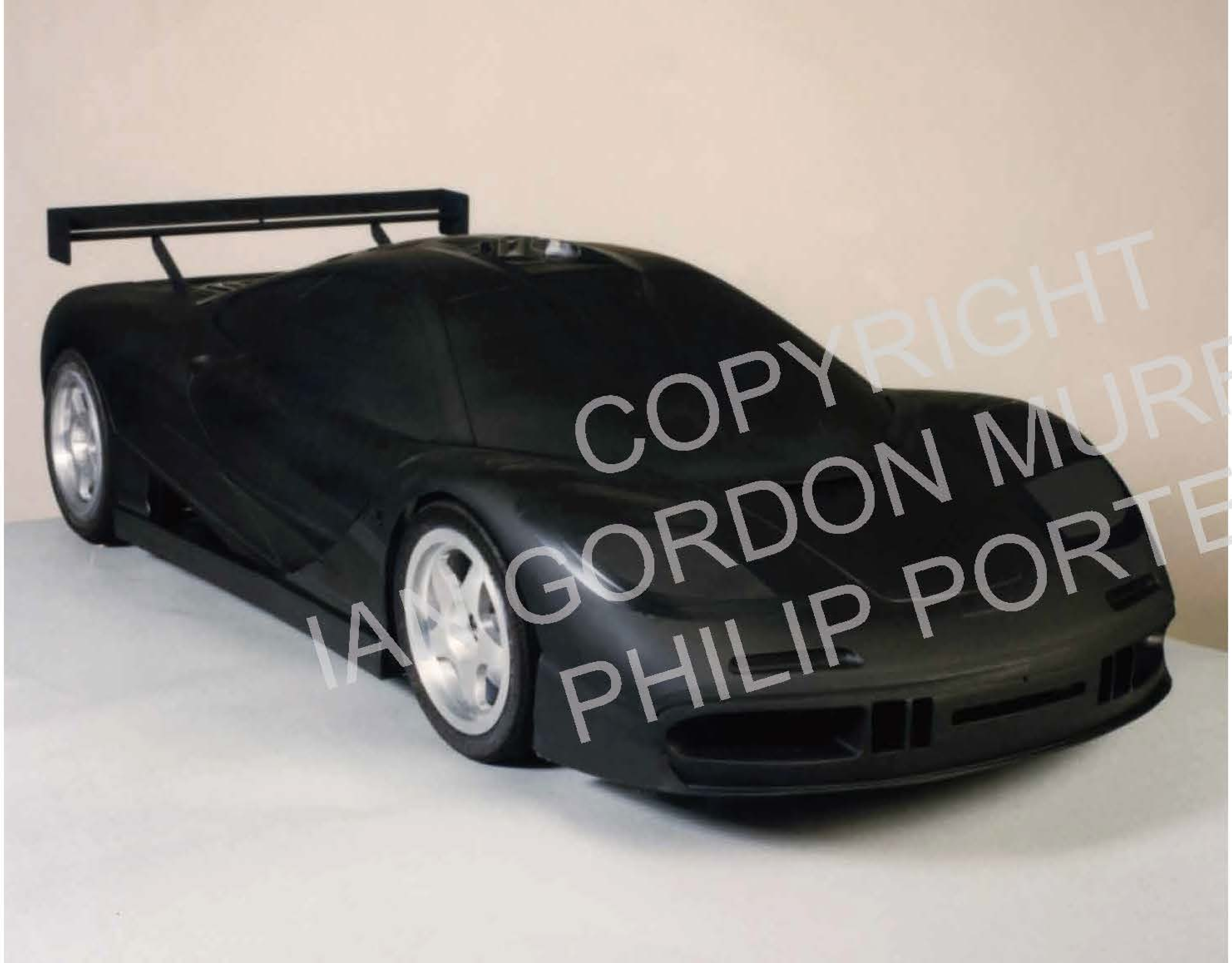


Above The very first test runs with the Rocket in bare, stripped form

McLAREN YEARS

F1 GTR

1994-1999



McLAREN F1 GTR

BPR GLOBAL GT SERIES

By 1994, as Gordon recalls, the BPR Global GT Series had gathered some momentum: 'They were starting to get a few interesting cars like the Ferrari F40, which was very quick, of course. It was actually more racing car than road car. But the whole concept was that it had to be a road car that was genuinely on sale, not something made for racing and then homologated afterwards for the road. And it worked. The Ferrari was the only one that was perhaps a little bit "out there" because it was really a racing car that you could drive on the road.

'But nevertheless, it raced and eyeing this growth over 1994 was Ray Bellm. He was looking at the F1 and thinking, wow, lightweight, stiff carbon fibre, ground-effect aerodynamics, lovely BMW 6-litre V12 – I think that could win some races.

'He approached us and said, 'I want to go racing. Could you turn one into a racing car for me?' I said, 'Absolutely no way. That's not going to happen because...' I explained our reasoning. Also, I said to Ron and Mansour, 'What happens if it doesn't win races? It should do, but I hadn't even thought about racing. It's going to be very difficult to lower it enough and keep the suspension geometry right. It's getting this reputation of being the best-engineered driver's car ever, and now we go racing and we don't win races. It's not super-good. Also, we're busy at the moment and it's quite of a lot of work.' Anyway, they kept pushing and pushing.

'By that time, I'd started talking to Jeff Hazell, who was working at our Shalford composites facility on the management side. We had two companies – McLaren Cars in Genesis in Sheerwater, Woking, and at Shalford we had taken over the lease from GTO Engineering, which had been [John] Barnard's UK R&D Ferrari unit, and bought the old equipment. I moved in there and started McLaren Cars Composites. Because it was the first carbon road car, there was nobody I could go to and say, 'Could you make the chassis? Could you make the body?' There was nobody. We had to do it all ourselves – Jeff was running that facility.

'Before McLaren, he'd worked with Gordon Spice. Jeff had a vast amount of experience with running racing cars, organising spare parts and working with customers who'd bought Spice racing cars. He'd studied the way that Porsche ran their customer engineering support, and also Ferrari. In his opinion, 'Porsche – not bad, Ferrari – terrible,' and we could do better and we should go racing.

'Jeff had been party to this, hearing about Ray Bellm, so he was the one that came and said to me, 'Have a look at it. I think it would be a good racing car.'

'I stopped shouting and I looked at it. When I really got down off my high horse, I thought, you're an idiot because you *are* a racing-car designer, you've designed it to be aerodynamically efficient, it has got ground effect, it has a stiff chassis, the suspension geometry is pretty good, the polar moment inertia is very low, the centre of gravity is very low. What are you worried about? It *will* make a good racing car.

Left The F1 GTR wind tunnel model. Gordon and the design team had only one day in the wind tunnel to develop the car

'The idea that I came up with for Project 2 was a higher-volume, lower-cost car. Now that we had the brand established with the F1, we could make something a bit more affordable – something like £150,000 or £120,000.

'I came up with the concept of a little 2+2. Rear-mid engine. Bit like a Porsche 911 with two small seats that could either be for luggage or kids. I looked at two different layouts. The basic concept was that it was going to be built in a much lower-cost way than the F1, so it just had some carbon fibre in and the body didn't have to be carbon fibre. I looked at using either BMW's M3 six-cylinder engine, sideways, canted over with the gearbox wrapped back round underneath it, or their V8 with a normal transaxle.

'I did some basic layouts, some sketches, and then worked it up into a proper design, worked out costs and put together a presentation. My idea was not to put any styling on the car because I didn't want to sway them. It could be either F1 family or BMW family. Right at the end, I got Peter Stevens back to have a look at it, and we decided to include one quick picture of what the car could look like as a BMW. I was never really happy with it, to be honest, but we decided to put that on the last page – sort of a visual of what the car could look like. But it concentrated much more on mechanical, manufacturing, geometry, layouts and design, with a business plan that sat behind it, covering timescale, costs and so on.

'I flew over to BMW, to a huge hall like an aircraft hangar where they present things. I sat at a lectern with these few slides and the main board members, and sold it to them.

'It seemed to go down pretty well but they didn't give me an answer. It obviously used a lot of BMW components to keep the costs down. It used a lot of running gear, hub carriers, brakes, steering column and stuff. That was the plan. It would be an affordable rear-engined 2+2, a collaboration between BMW and McLaren. I saw it as really getting the company flying. Now that we had established the brand, this one would start making money. We were talking of making about 1,500 a year. I can't remember the price, but it was more affordable. Sort of low Aston Martin money, high Porsche money.

'I kept in touch with BMW and Rosche phoned me up one day and said, `Do you want some really good news? I've just heard that Reitzle has given it the go-ahead.` So now we could get into much more detailed design and costings and stuff. I went back and told everybody, because we weren't a big company; we had the Shalford facility but they were not doing much. They made all the racing-car bits and things so they had a nice little turnover. I had a design team there and a workshop team, and the build team. I needed something to keep the business going, so that was great news. That was the design side of Project 2.

'I was up at a `do` in London – cocktails and dinner – and I was with Stella, and Ron was there and a lot of McLaren people. We were wandering around with cocktails and chatting to everybody and Ron pulled me to one side and said, `I've got some really exciting news to tell you.` And I said, `I've got some really exciting news to tell *you*.` He'd known what I was doing with the BMW thing.

'He said to me, `I've just signed a five-year deal with Mercedes-Benz for Formula 1 engines.`

'I said, `Pardon? I'm a director of the company. Why didn't I know?`

'He said, `I had to keep it secret and it's been a tough negotiating process.`

'And I said, `But you've just killed my company.`

'`What do you mean?`

'`You've killed the car company. BMW and the road cars, and Mercedes and Formula 1. BMW will never accept that.`

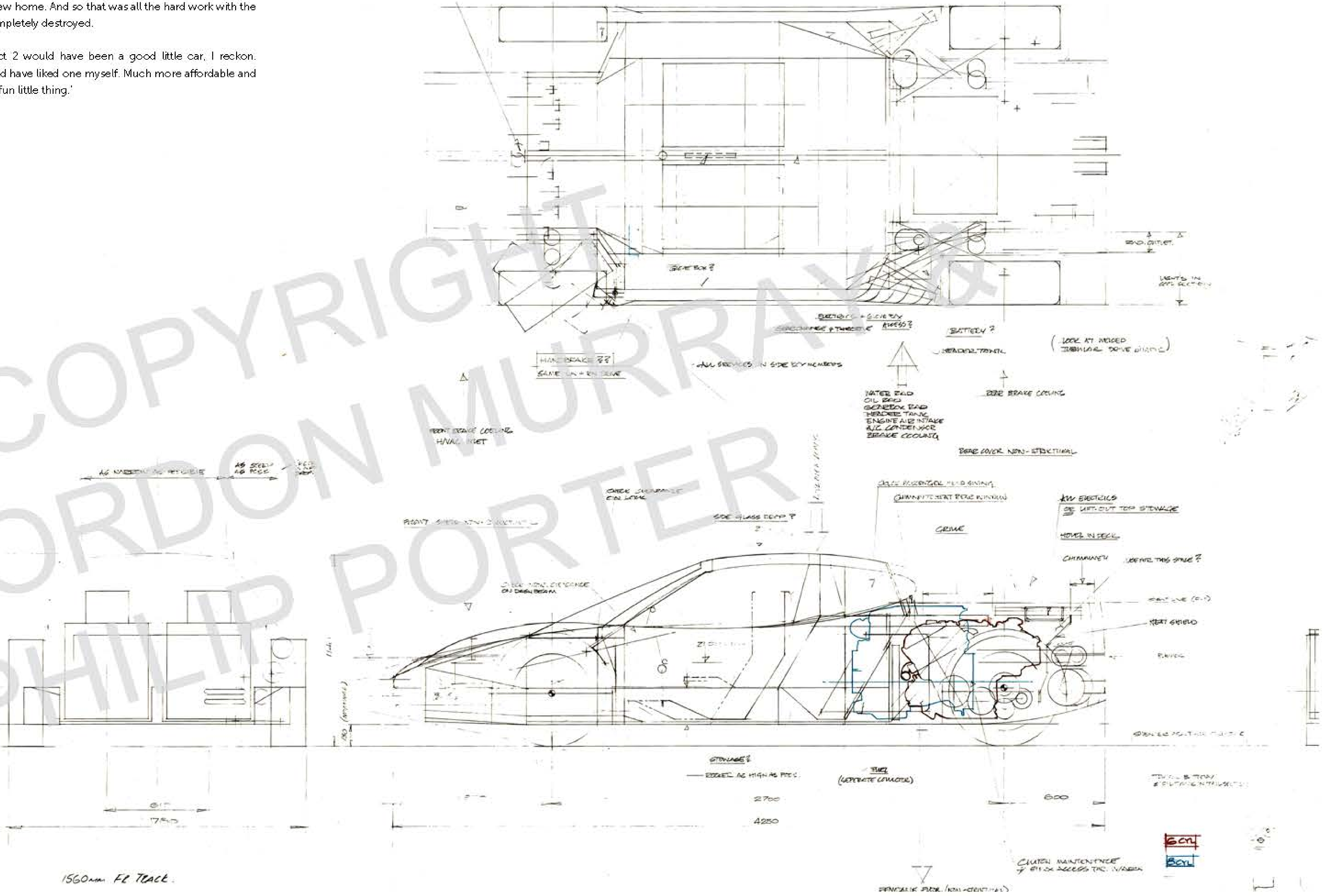
'`Oh no, don't worry, it'll be fine.` I was so pissed off, I just grabbed Stel and we stormed out and went home.

'Then, a few weeks later, we got the call from BMW to say, `Come across and meet Reitzle about Project 2.` I said to Ron, `You know, this is never going to happen now.` Ron knew that they'd already said that they were going to give us the green light. We flew across in the company jet and BMW had an office in an aircraft hangar in the private aviation section, which is brilliant because you literally taxi the plane up, get out, walk 50 yards and you're in the office. You have your meeting and off you go.

'On the way over, I was saying to Ron, `You know, it's a waste of time.` Ron said, `You're an engineer, you don't know anything about business. Just watch, it's going to be fine.` We get out and we walk into the office and Paul is beaming all over his face because he knows that we're waiting for Reitzle to come in. And he knows what Reitzle's going to say. We had a coffee or something and eventually Reitzle turns up, shook hands and just before he was about to start his spiel, Ron said to him, `Dr Reitzle, there's something that you have to know. We've just signed a deal with Mercedes-Benz for Formula 1 engines for five years. It doesn't have to affect the car company at all.`

'Reitzle looked at him, put his hand out, shook his hand and said, `Goodbye,` and left. We walked back to the plane and flew home. And so that was all the hard work with the F1 completely destroyed.

'Project 2 would have been a good little car, I reckon. I would have liked one myself. Much more affordable and just a fun little thing.'



Above Gordon's original layout for the McLaren BMW Project 2. Both transverse V8 and straight-six engine configurations were studied

1995

McLAREN GTB V12 BRUNEI 2+2 SPECIFICATIONS

GHOST VEHICLE

Weight	**1,300 kg**
Engine	**6-litre Mercedes-Benz V12**

Design notes

Design-only car for Brunei

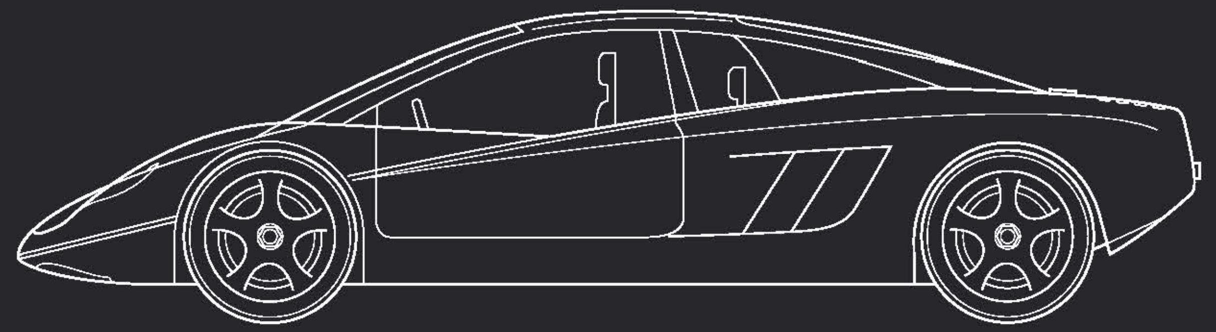
McLAREN GTB 2+2

V12 CAR FOR BRUNEI

This was another project that was done for the Brunei royal family: 'In that period, the Sultan of Brunei and his family were very, very powerful. The Sultan would do things like fly cricketers over to play a game and hire very famous people to come and play rock 'n' roll at parties.

'We heard from Brunei that the Sultan's nephew was interested in making his own car and he'd driven the F1 several times and had a couple of them, and could we fly over and talk to him? So I thought, anything is better than nothing. I jumped on an aeroplane and went across there, at least twice. He also had a huge house in the Regent's Park area, and I met him there three or four times to talk about the car.

'What he wanted was a sort of Aston Martin-type sports GT, with a V12, preferably a Mercedes V12, and 2+2 layout. That's the sort of thing he was after. I'd gone over there with some ideas and designs anyway. We'd taken the F1 chassis and I'd got Peter Stevens back in – whenever I needed some pretty drawings and sketches, I got Peter involved. He did some renderings of cars on an F1 chassis, which I took over with me, but that's not what he wanted. So I did a quick layout for a front-mid-engined V12, and some body designs myself – just some outline drawings. Actually, that went nowhere in the end, but at least it kept us busy for a little bit. And that was the lead into Project 5.'



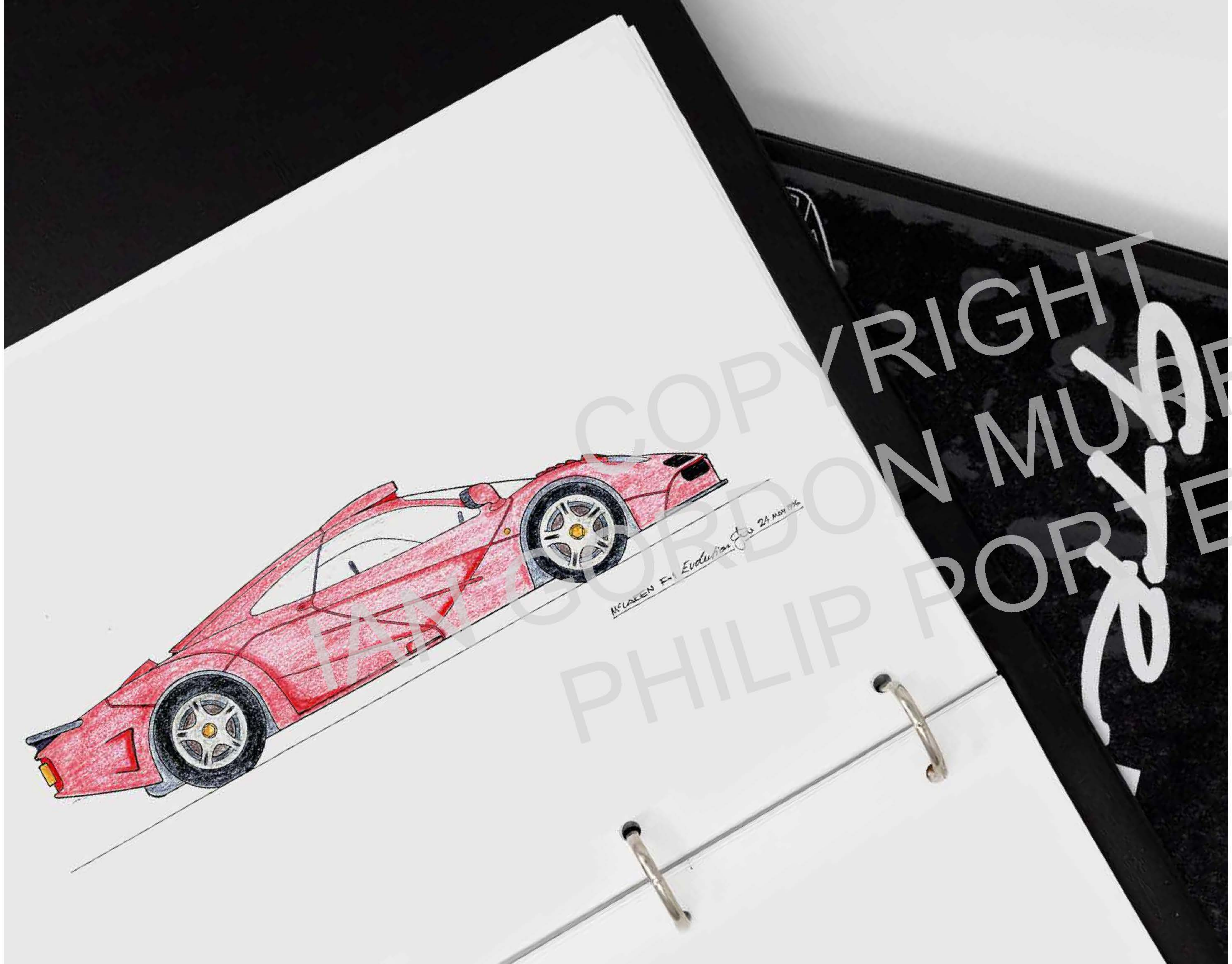
McLAREN F1 GTR

BPR GLOBAL GT AND LE MANS

'The second GTR was created in 1996, and that was fairly simple, being just an update. We'd raced the cars for a year and we didn't have any worries about it being successful, but we could see that there were a few small weaknesses in the operational bit of the car. In '96, we just tried to fix those issues as we did with Formula 1 cars – tried to make it a little bit lighter and little bit better.'

Work began on the '96 car a month after the Le Mans win. The engine was mounted lower and the steering, cooling and braking were improved, as were the electronic control systems. New uprights and suspension pick-up points were adopted, and aero work was done in the old Brabham wind tunnel: there were revised side panels, the body was extended front and rear, and a front splitter added.

Meanwhile, Paul Rosche and his team at BMW made a variety of changes to the engine in order to cope with the revised – and reduced – air restrictors that were decreed for 1996. A redesigned and lighter transmission reduced power losses. Overall, some 70kg was saved and the power unit produced 600bhp at 7,300rpm. Nine new cars were completed.



McLAREN F1 GT

LONG-TAIL ROAD CAR

'During the 1995 season, people could see that the BPR Championship had really matured and become a global series. They started to go to China and places like that, and I think they'd been talking about having a round in America. So people started sitting up and paying attention and, because we were winning everything, it obviously looked easy from the outside looking in.

'Porsche, who had been out of that sector for a bit, woke up and took a long hard look at it. They decided that they'd probably be powerful enough, because any organisers would want Porsche back in again, to successfully exploit the rulebook. The regulations said it had to be a genuine road car, you had to be producing them for a year, you had to have proper sales brochures printed and prove that you've made a few cars, and that they'd been on sale for 12 months. Then you could start racing.

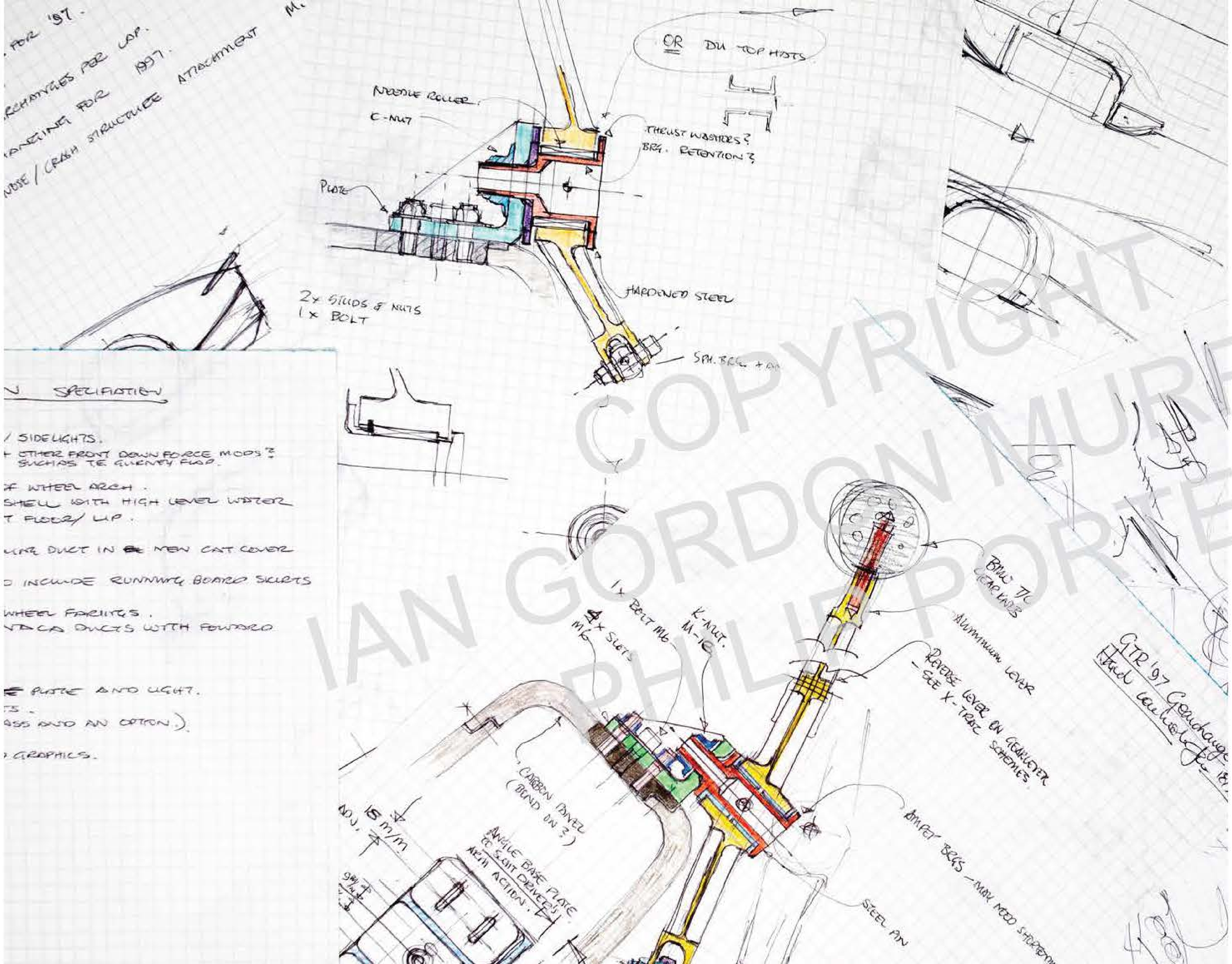
'Porsche very cheekily did a GT that was a pure racing car, absolutely designed from scratch – low ride height, all suspension geometry correct for that ride height, long nose and long tail for the overhangs for the aerodynamics, stripped down completely with no creature comforts, proper racing gearbox, racing engine. Then they approached BPR and said, "We'd like to race this."'

The GT1, as it was known, has been described as more 962 than 911, especially as it was mid-engined rather than rear-engined.

'I was chosen as a representative to go over to Weissach, look at the car and look at the factory, and report back with a team of people to the FIA. It was pretty obvious, even before we got on the plane, that they were going to race the following year, even without the 12 months and without making a road car first. So they then made two and sold them as road cars, and made some brochures. They still hadn't complied with the 12-month regulation, but they were going to be let in because their presence made the events much more prestigious.

'We were racing the standard short-tail version of the F1 in '95. The short tail had a big disadvantage because the road car had very little rear overhang, and the regulations said the rear wing had to finish where the car finishes.'

Left Gordon's sketch of the long-tail road car, which was required by homologation regulations in order to build a race version



McLAREN F1 GTR

FIA GT AND LE MANS

The F1 GTR benefited from a number of modifications that amounted to a weight saving of 100kg, on a car that was already the lightest in its class. The rear of the monocoque was changed, while the driveline and suspension components were redesigned and lightened. One extreme weight-saving measure was to bolt the rear end of the powertrain through the structural floor and manage all the lateral cornering forces with unidirectional fibre in the composite floor.

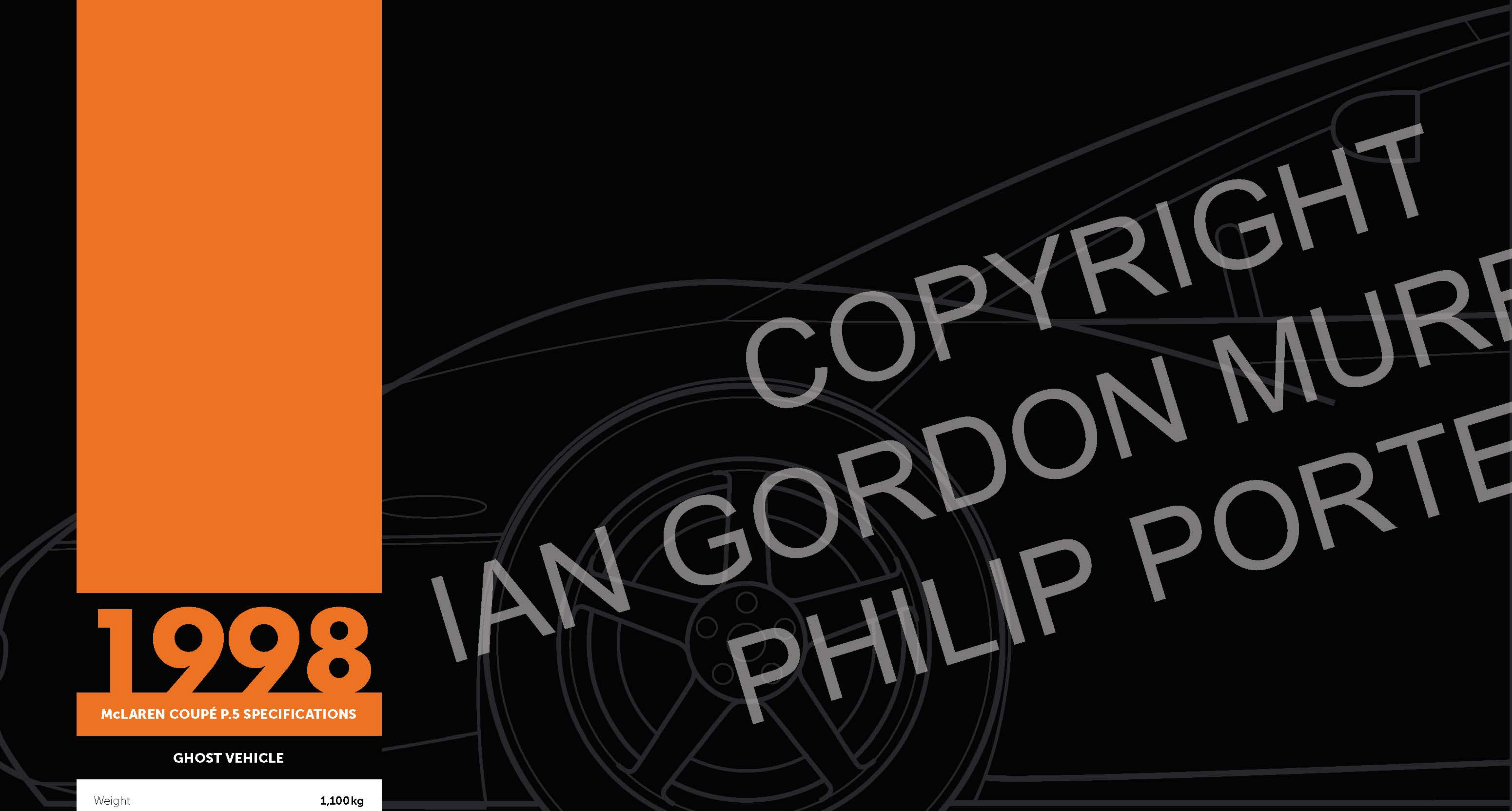
An Xtrac six-speed sequential gearbox was adopted and housed in a new magnesium alloy casing. BMW reduced the weight of their V12 by 25kg and employed revised con-rods, camshafts, titanium exhaust and carbon fibre cam covers. The engine stroke was slightly reduced for durability reasons.

As to the new longer and wider bodywork, the revised tail incorporated an extended diffuser and the single-plane rear wing was reprofiled.

BMW Motorsport McLaren F1 GTRs won the first three rounds of the new 1997 FIA GT Championship. At Le Mans, however, the Porsche GT1s held a commanding lead until both dropped out. The 1996-winning TWR-Porsche prototype took a second successive overall victory, but was only a lap ahead of the Gulf Davidoff F1, with one of BMW's F1s in third place. The two McLarens therefore finished first and second in the LM-GT1 class and came close to winning Le Mans for a second time.

'We were looking like winning the GT Championship again, but then Mercedes-Benz just did exactly what Porsche did, except they didn't bother to sell any road cars. In 1997, they just built a racing car, went to the organisers and said, 'We'd like to enter now' – and the organisers rolled over and said yes. Mercedes turned up with this CLK-GTR, which was absolutely a pure racing car. They beat everybody, basically.'

Left Gordon's design sketches for the quick-change sequential racing transmission



1998

McLAREN COUPÉ P.5 SPECIFICATIONS

GHOST VEHICLE

Weight	**1,100 kg**
Engine	**4-litre V8**

Design notes

Design only

McLAREN COUPÉ

P.5

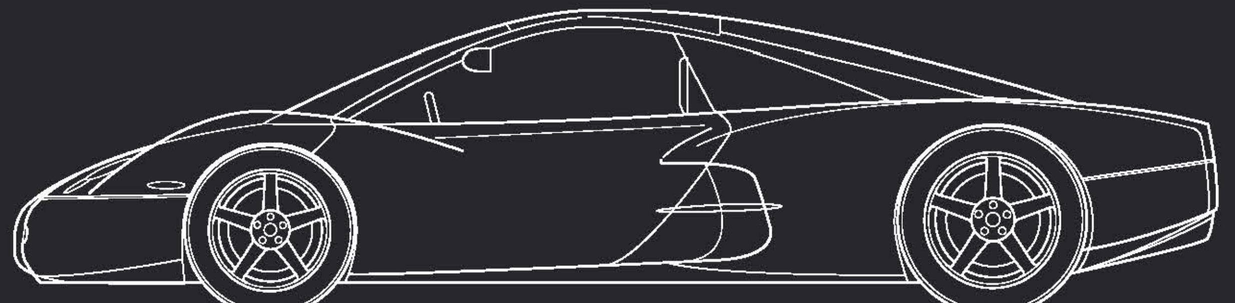
'I'd been saying to Ron, "Mercedes destroyed the car business. They should give us some work. We've got a car company, we can't do anything with BMW, we should be trying to do the same thing with Mercedes." So, with that in mind, I set about designing unilaterally, not with Mercedes, but for Mercedes.

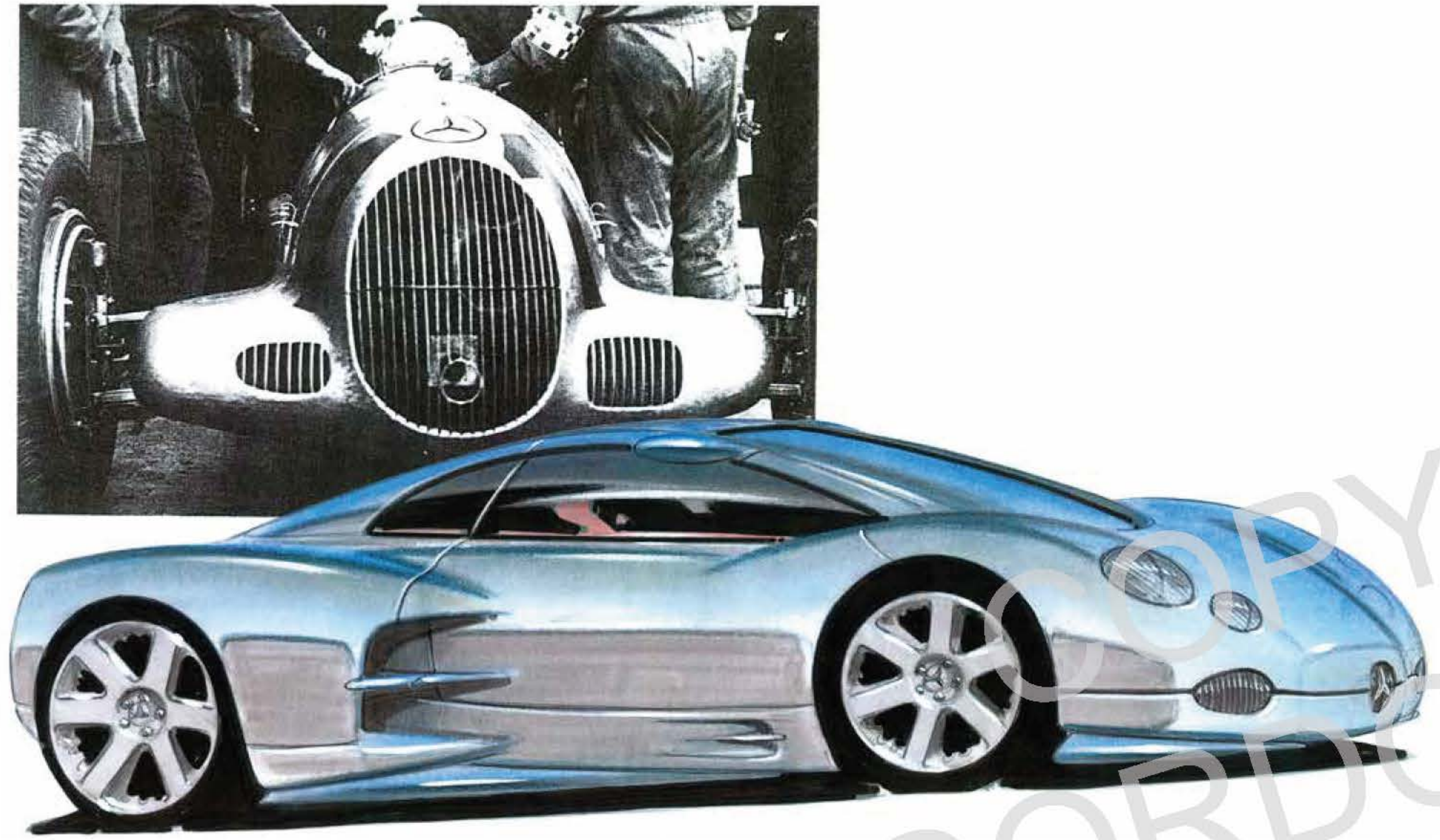
'We picked one of their V8s and I came up with a concept for a much more affordable sort of mini-supercar, rather more like Project 2 with BMW. It was a two-seater, rear-mid-engined car with a really nice layout. We did all the layout drawings and all the weight-distribution calculations. It looked really good mechanically, using all Mercedes running gear and brakes and things. I think it could have been a fantastic little motor car. It would have been head-to-head with Ferrari, but much better quality and equal performance.

'The way I designed the monocoque, it could have been made in 1,000 units a year. I had an idea for the body styling. I wanted to try to mirror the pre-war Mercedes, because it had side radiators.

Everybody else tried to do flash intakes, like the Testarossa had the strakes, and people were trying to do flash NACA ducts. I just had this wacky idea that if it was going to have side radiators, why not be more like a jet and say, "I've got side radiators", and build these two very powerful-looking inlet ducts that stuck out from the car to make it look really butch.

'Then the front of the car, instead of doing a pretend grille like most people did, it wouldn't have any grilles and be more like the 1930s Mercedes, which just had little slots in the front. That would be the carry-over from a Mercedes brand point of view, and be very different from what Ferrari, Aston, Porsche, anybody, was doing.





Above This rendering of Project 5 was done by Peter Stevens, based on a design that was worked up by him and Gordon

'I wasn't good enough to do renderings, so I got Peter Stevens back again and talked through with Peter what I wanted, and gave him the sketches. Peter took them away, because he was working on his own from his place and came back with this stuff that wasn't anything like it. It looked like an Audi or something, and I didn't like them at all. I said to Peter, "Don't go away. Sit here with me, like we did with the F1, and let's work it through together." And we worked through this concept. If you think how long ago that was, if you saw that car come past even today, it would still be quite a startling, pretty car. Peter and I always worked best as a team.

'I realised they wouldn't buy it just on the design so we needed to do a business plan. I produced an A3 folder of about 30 pages, on how the car would be built, how it would be designed, how it could achieve our aims, and right at the last page were the finances.

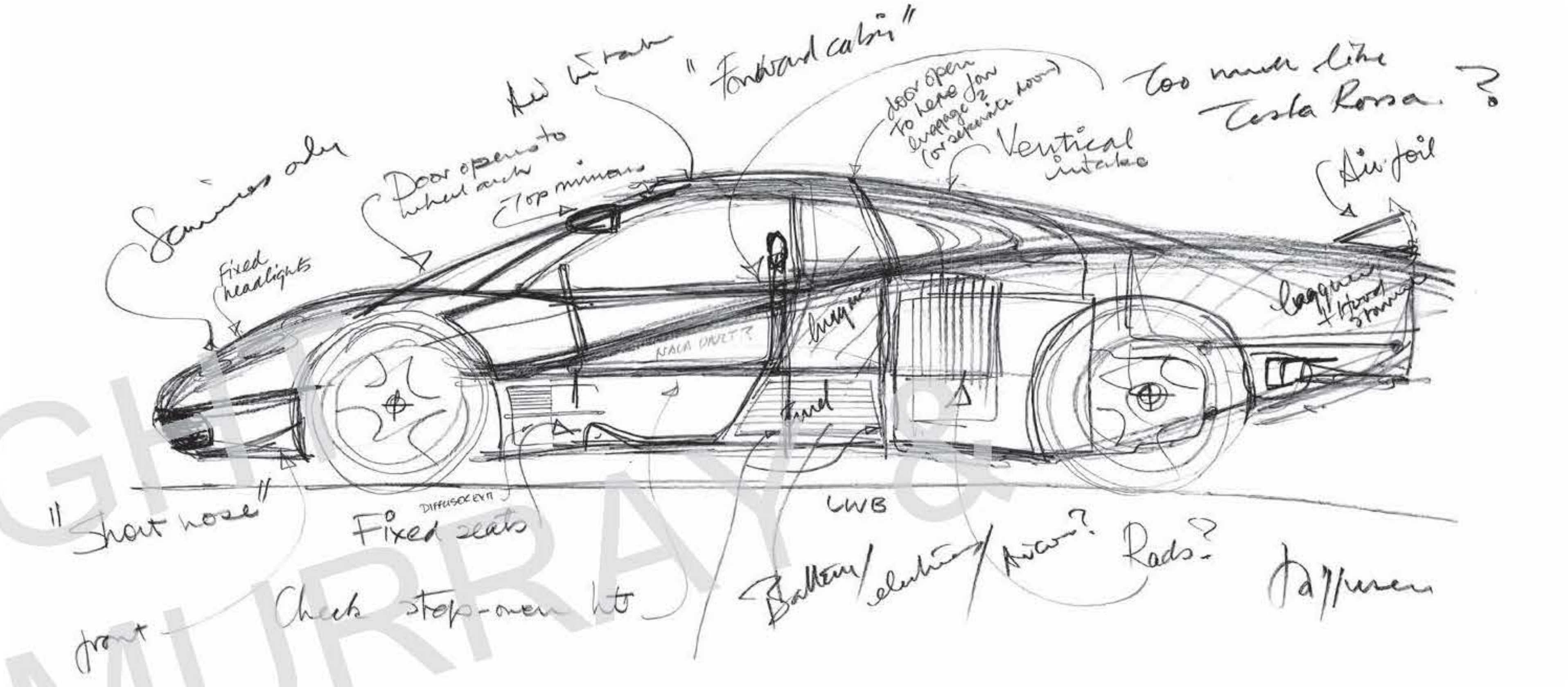
'Ron Dennis and I jumped on an aeroplane, and flew over to the Mercedes headquarters and sat with Prof Hubbert, the Daimler Chrysler board member responsible for passenger cars. I went through it and he was interested, until I got to the last page and the finances, and he looked at the numbers. There was a sharp intake of breath: "Before I show it to the board, can we tear out this page?"

'I thought, well, I reckoned it was pretty reasonable myself. We are a small team, we can do stuff cheaply. And I said, "OK, we can, but what's the problem?"

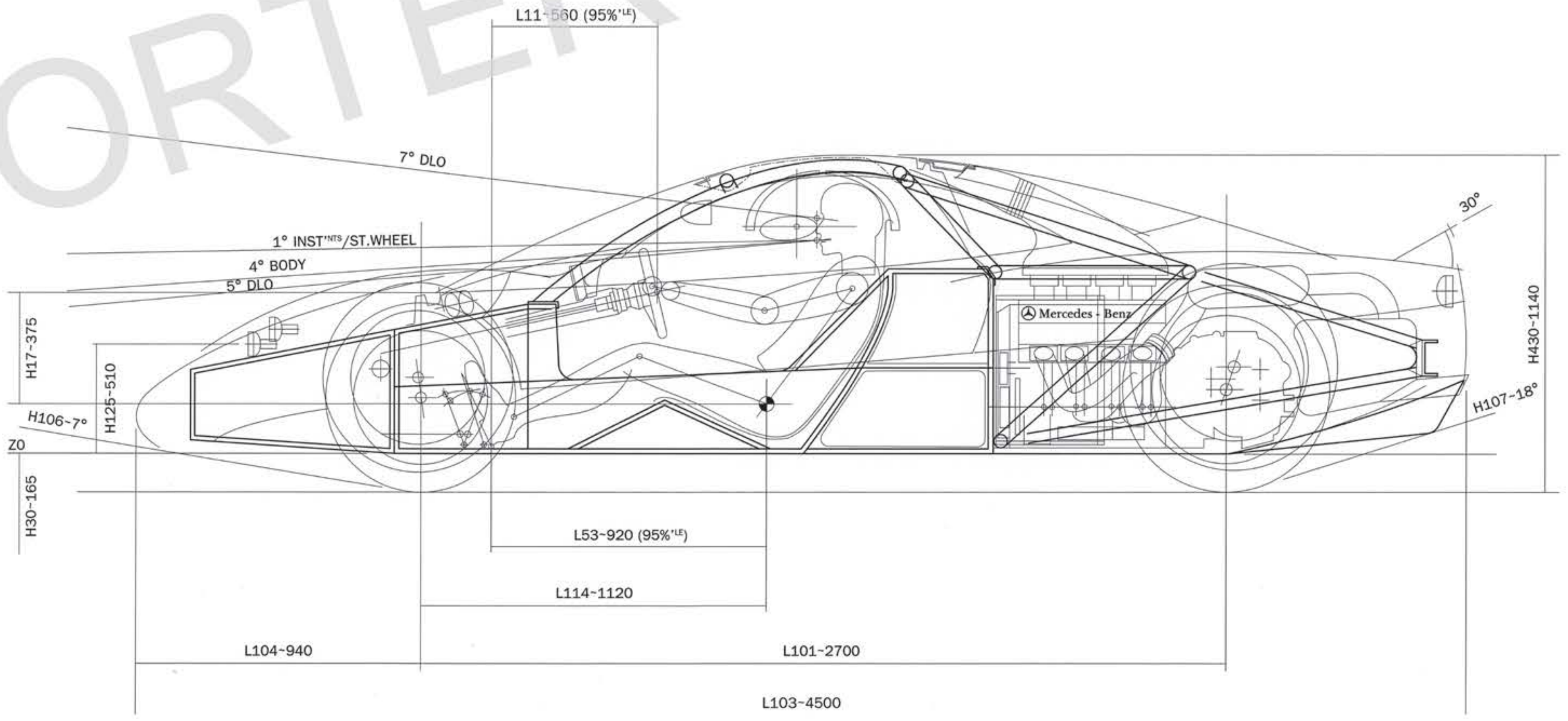
'He said, "It's much too small a number; they will never ever believe that." We tore out the page and gave him the thing. I came back and told the guys I thought he liked it. I told them the story about the money, said, "I think we're quids in here," and heard nothing at all for about three months.

'I was trying to keep the guys interested and busy, and picking up Project 3 again and doing a bit more work on that. In the meantime, I was just waiting, waiting, waiting. This was all around 1998-99.

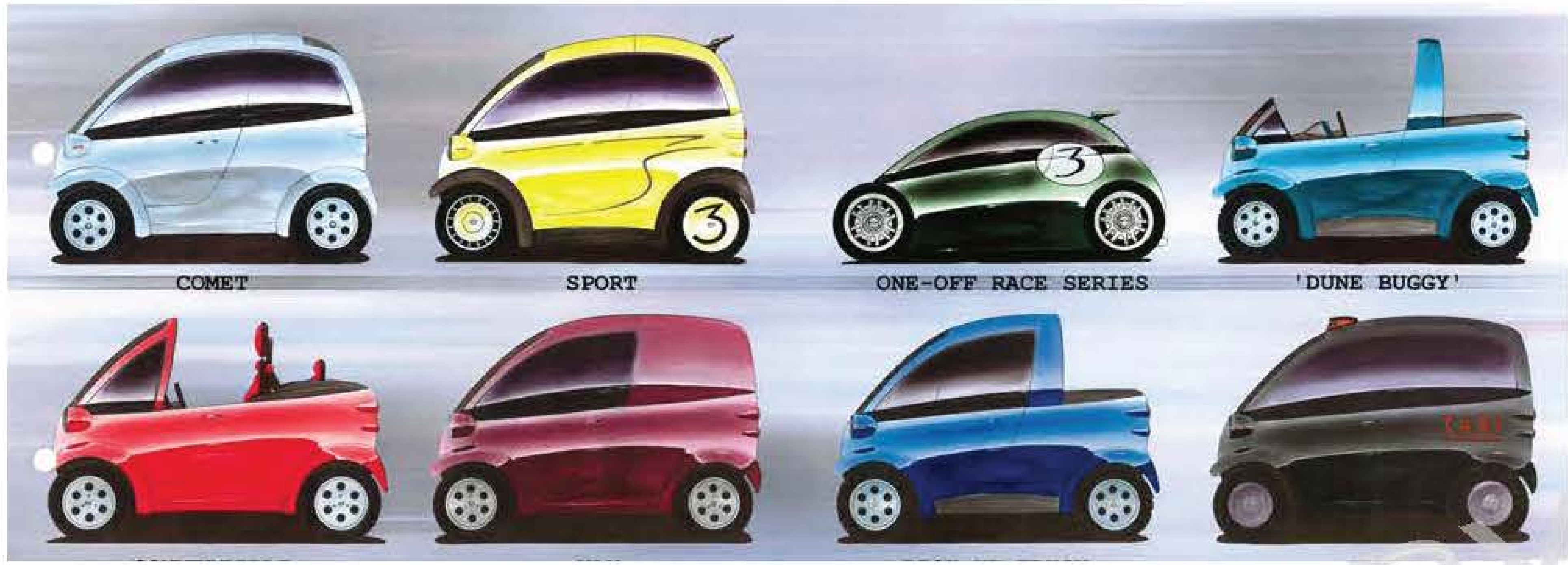
'After three months, Mercedes came back and said, "The good news is we've got a job for you; the bad news is it's not Project 5. It's going to be the show car that we displayed at the Detroit Show in January 1999 – the Vision SLR." Ron was too frightened to tell me in case I wouldn't do a front-engined car, but actually I was just looking for something for the company to do. I was over the moon that they had come back with something.'

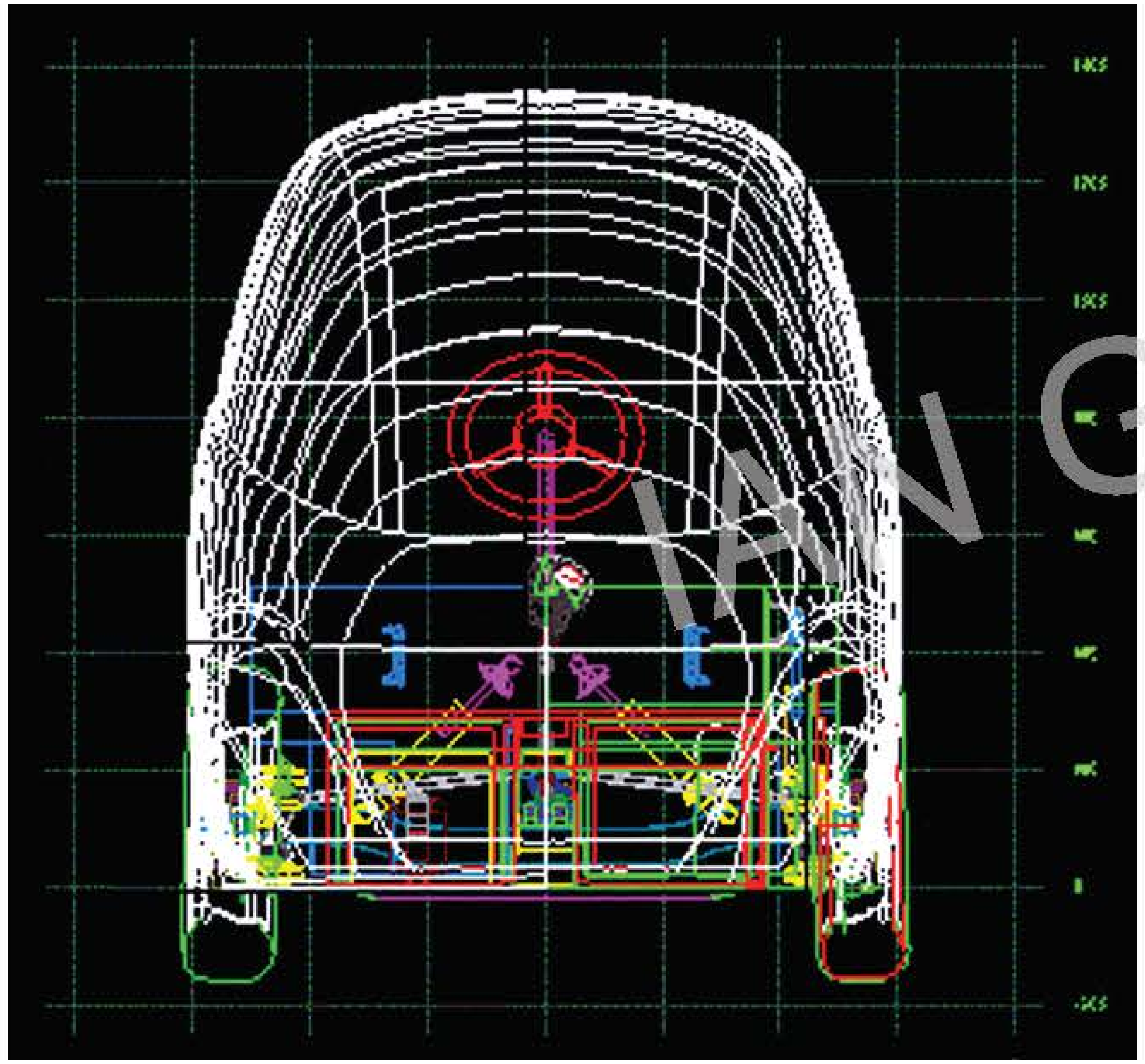


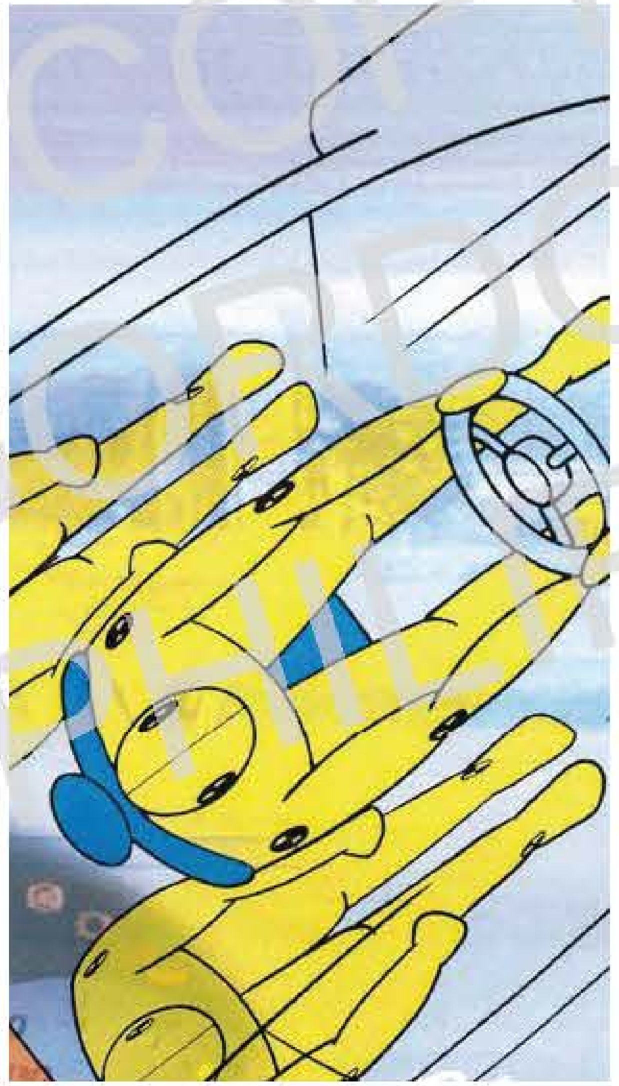
Above Gordon's original concept sketch for the project is seen here



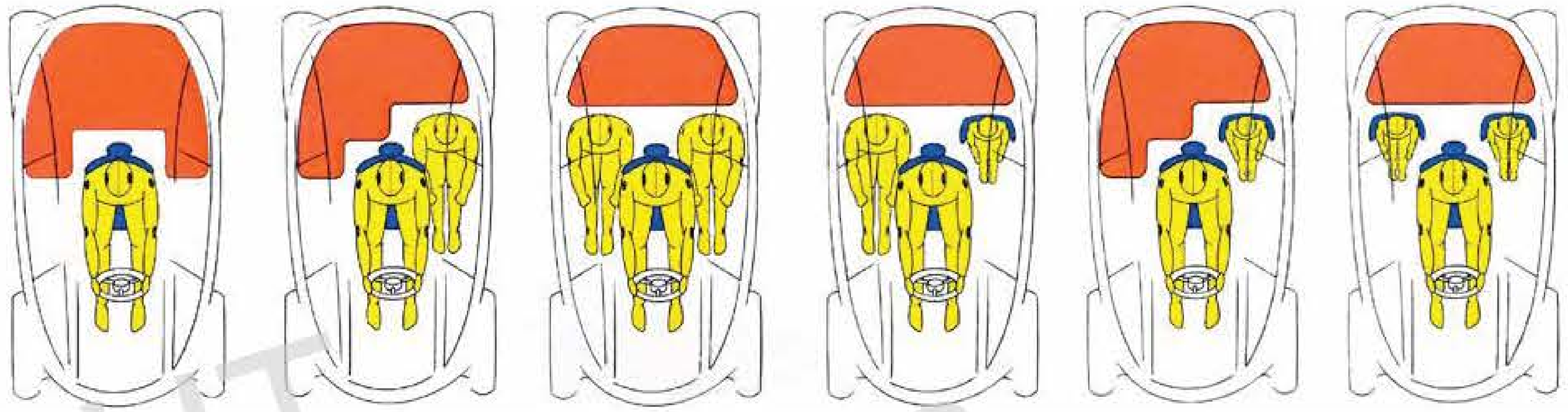
Above This package drawing for the V8 sports car was designed by Barry Lett







Above The beginnings of iStream – Project 3 at McLaren Cars was a 'filler job' for the 12 months after BMW had pulled out of Project 2 due to McLaren signing a Formula 1 engine contract with Mercedes



Top Drawings showing the potential cockpit layout

Above Gordon trying it for real in a basic wooden buck

McLAREN YEARS

MERCEDES-BENZ

2000-2005

MERCEDES McLAREN SLR

T.24

'Mercedes said this Vision SLR was supposed to be the reinvention of the old 1950s SLR coupé and they wanted to use our carbon structure. I was so pleased to have anything for the company to do and I thought we could make a good job of that. I didn't like the styling particularly: it was very bling, very Hollywood Boulevard-cruiser type of thing. Didn't remind me much of the '55 SLR, which was a lovely shape. And it looked very wrong aerodynamically, but anyway it was a job.

'Their stylist had drawn a body and given it to coachbuilders in Italy somewhere. They'd built this body to their styling and plonked it on a current SL chassis. I flew over to Mercedes and looked at it. We had a meeting with all the board members, directors and senior people, and I said to them, `What is that supposed to be in competition with?` They replied, `Aston Martin, Ferrari, Lamborghini – all the top-end people.`

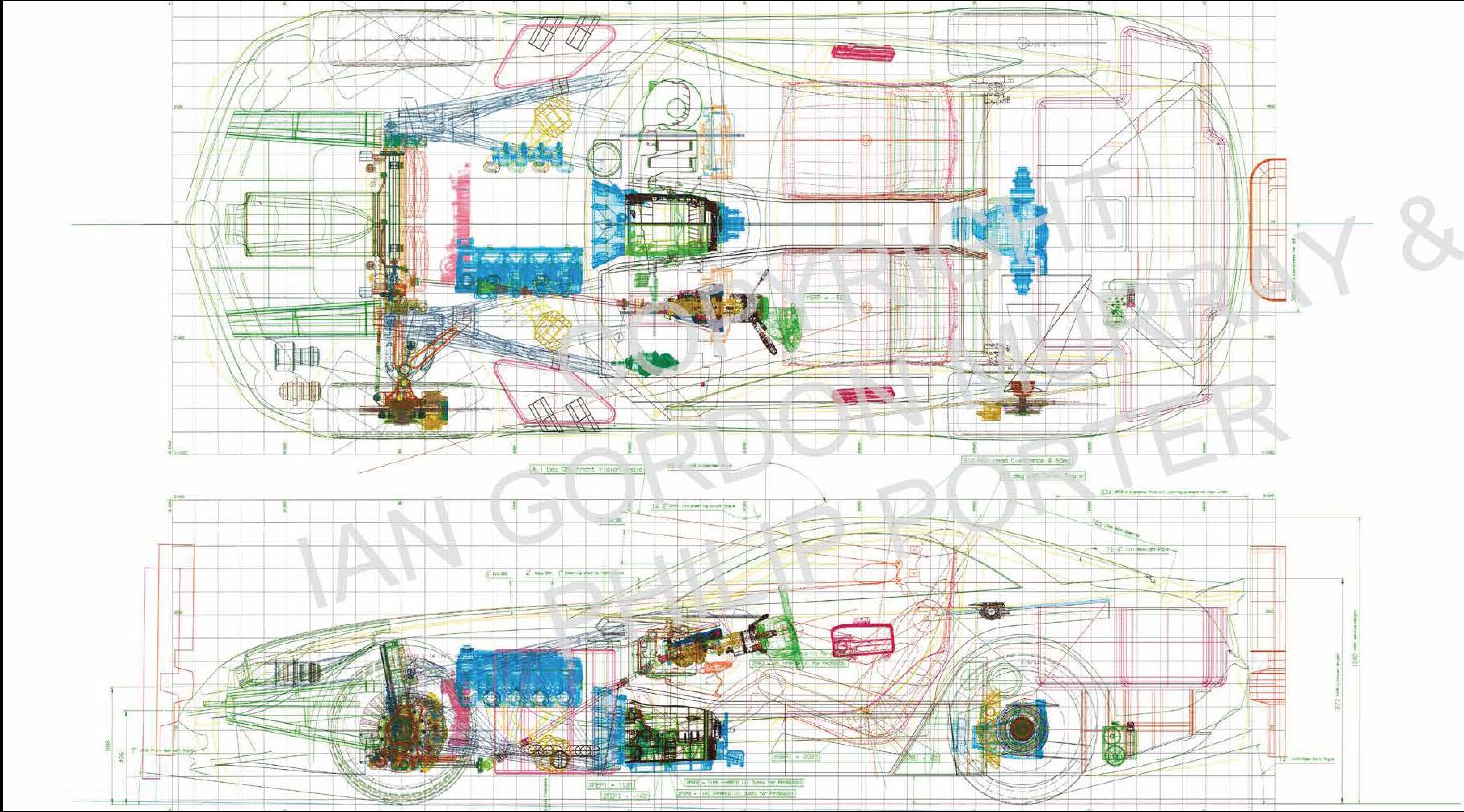
'And I said, `But it's not a front-mid-engined car; it's a front-engined car. It's got no boot space, the fuel tank is high up in the air above the back axle, it's got these huge pneumatic suspension struts on each corner that weigh 9.5 kilos each, and I can see from right here that the weight distribution is completely wrong. It's got way too much weight on the front axle. Forget it. Much as I'd love the job, forget it because it's never...`

'What I really wanted to say was, `I don't want us to have our name on this car. It's never going to handle, it's never going to perform, and it certainly won't be in competition with those guys you've just mentioned.` And there was a lot of biting of tongues and gnashing of teeth for a bit, but they did come around and say, `OK, will you tell us what it has to be?`

'I went back home again and we did a little leaflet. It was a bit, `The cat sat on the mat`! It said, `This is a sports car, this is a GT car and this is a saloon car. And a sports car must have this weight distribution.` Stuff like that. I said, `We would love the job, but you're going to have to let us change the architecture completely – absolutely start again, and it can't have any of those heavy struts and stuff.`

'I said, `It's going to look completely different. We will try to keep the styling as close as possible, but the architecture is going to have to be completely different.` The engine had to move back almost a metre in the car to get the weight distribution from where they had it.

Left The SLR was intended to evoke the famous Mercedes from the 1950s. Gordon and his team had to make sweeping changes to the manufacturer's original concept



FRANK COPPUCK COMMENTS

'When we finished running the F1 GTR at the end of 1997, we had a little bit of a pause, then started looking at doing an LMP1 car. Unfortunately, it was one of those projects that never went anywhere.

'We also began to look at a new concept road car – this was the start of the SLR programme. Despite its many critics, I have fond memories of it because I was responsible for all the design work regarding powertrain integration, and headed up the actual car development itself. I got to do a complete development programme to full Mercedes-Benz standards, including crash, homologation, heat management, hot- and cold-climate testing, powertrain durability, structural durability, ride and handling: in essence, the whole car programme. That was a dream job.

'For the dynamics, it always makes me laugh that whenever we did a review, we'd have a Ferrari Enzo or something like that as the benchmark, and when we did NVH and ride quality they'd bring out an E-Class, or an S-Class. The SLR, in some respects, never knew what it was meant to be. Nonetheless, we were very proud of the engineering that went into it.

'Gordon set some tough targets with the weight distribution: the engine was pushed back as far as we could get it. We wanted a full flat bottom with diffuser ground-effect car, which we achieved by having side-exit exhausts. That brought many challenges, such as heat management in the engine bay.

'When we did the first shakedown, it felt so awful that I wanted to jump off a cliff. But we got to work and slowly chipped away to sort the handling, the NVH issues and the heat-management issues. We worked through them very carefully and in a logical way. The people from Mercedes were excellent – very helpful and so keen and enthusiastic to be part of a highly focused team.

'Gordon is quite a tough target-setter: he's relentless in pursuit of getting the ideal solution to any given problem. For him, the solution was to get the engine back to where he wanted it for weight distribution, with side exits so we could get a full ground-effect car. It really pushed us to the limit on finding solutions.

'Gordon surrounded himself with really good people, but the vision of the car was always his – except, of course, in this instance the styling. Its dynamics and reliability were down to his drive.'

Left The SLR was the world's first front-engined ground-effect car. This package drawing shows just how far back the power unit was to achieve as near a mid-engined layout as possible

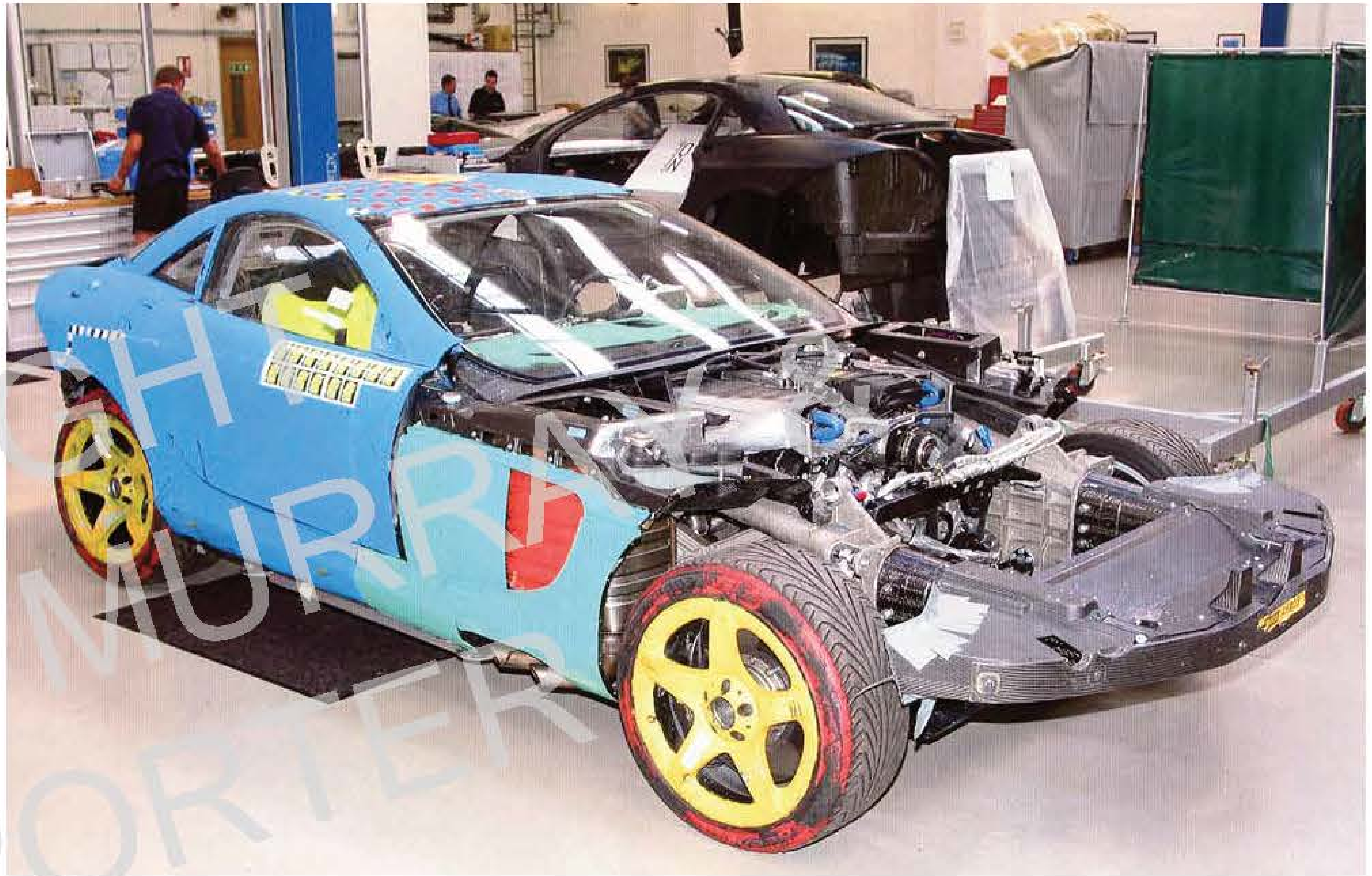
Above The woven and sewn front crash structures weighed just 3.5kg each. These were developed with the Mercedes R&D team

'I don't think they really understood rolling-road wind tunnels very well, so Frank Coppuck and I offered for their head of aerodynamics to come across for two or three weeks and stay here, and visit the tunnel every day with us. We played with cardboard and stuff, and ultimately we had to restyle the car, aerodynamically, to make it stable and get the central pressure in the right place, and produce a bit of downforce. We still managed to keep their overall styling but it did have to change quite significantly.

'We missed the weight target for two reasons. The first engine we received from AMG was 85kg heavier than they said it would be. That threw the weight distribution out of the window, and caused us all sorts of problems. Then the spec just got more and more luxurious.

'When I took the job on, and I was happy to have the job for the company, the spec was supposed to be no higher than that of a sports car. It was not supposed to be a soft GT, but somewhere nicely in the middle. It had a huge identity crisis with the continual pushing and pulling between McLaren and Mercedes, and it didn't really know what it wanted to be in the end. Because the spec kept changing, the weight kept going up, and suddenly we needed two batteries because of this braking system and stuff like that.

'We missed our weight target by a long way. It's still a relatively light car, but the fact that it's supercharged meant it needed seven radiators. I wanted to put a normally aspirated engine in and I wanted the styling to be like the original SLR, and I actually did some styling drawings around the package of what I would have loved to have done. But they were absolutely adamant that when they showed the Vision SLR in Detroit the public liked it, the management liked it and that's what it was going to be. The styling was really a bit of a dead end, to be honest.



Above The safety cell was so strong that no damage or intrusion was experienced in any of the crash tests. Because of this, the same chassis was used for multiple tests. The graphics department designed a special sticker that was put on the car after each test. This chassis has already accumulated 14 of them!

Above Airbag development covered both Federal and European homologation requirements

Above Carbon ceramic brakes and aluminium disc bells on the SLR

'I had drawn a layout for a revolutionary design and prototyping office that would have placed McLaren Cars at the very top of the car design capability list. This layout flourished under the original design, which was produced by that brilliant architect Terence O'Rourke, but it disappeared when Norman Foster and Ron took over.

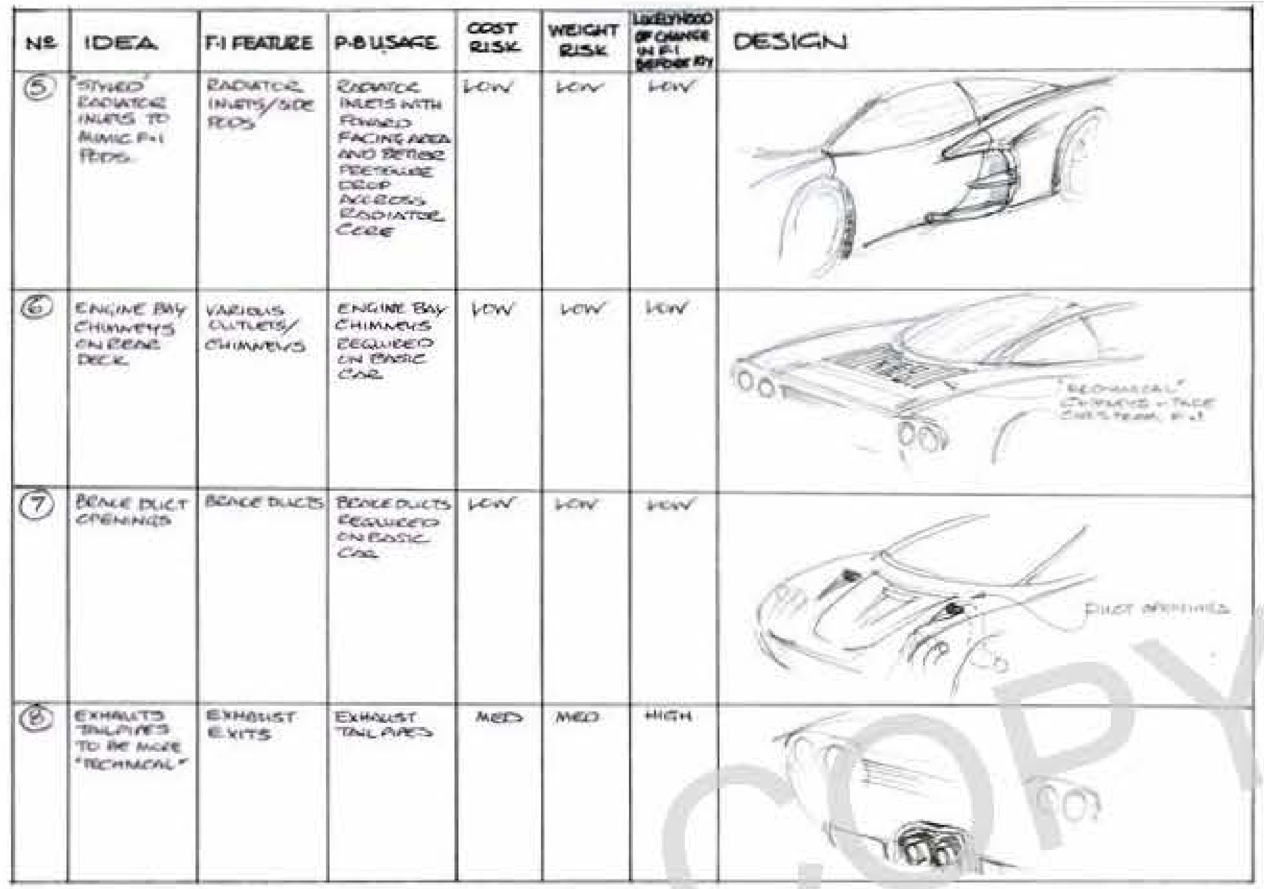
'A combination of the new building and Anthony Sheriff did nothing for my enthusiasm or my confidence in my company's future, so instead of moving to MTC, I stayed in our historic McLaren Cars home in the Genesis building and kept a small team of designers in an advanced concepts group.

'Our mission was to develop ideas for a new sports car platform that retained our carbon fibre chassis for performance and marketing reasons, but using a new manufacturing system that would facilitate the production of higher volumes of chassis.

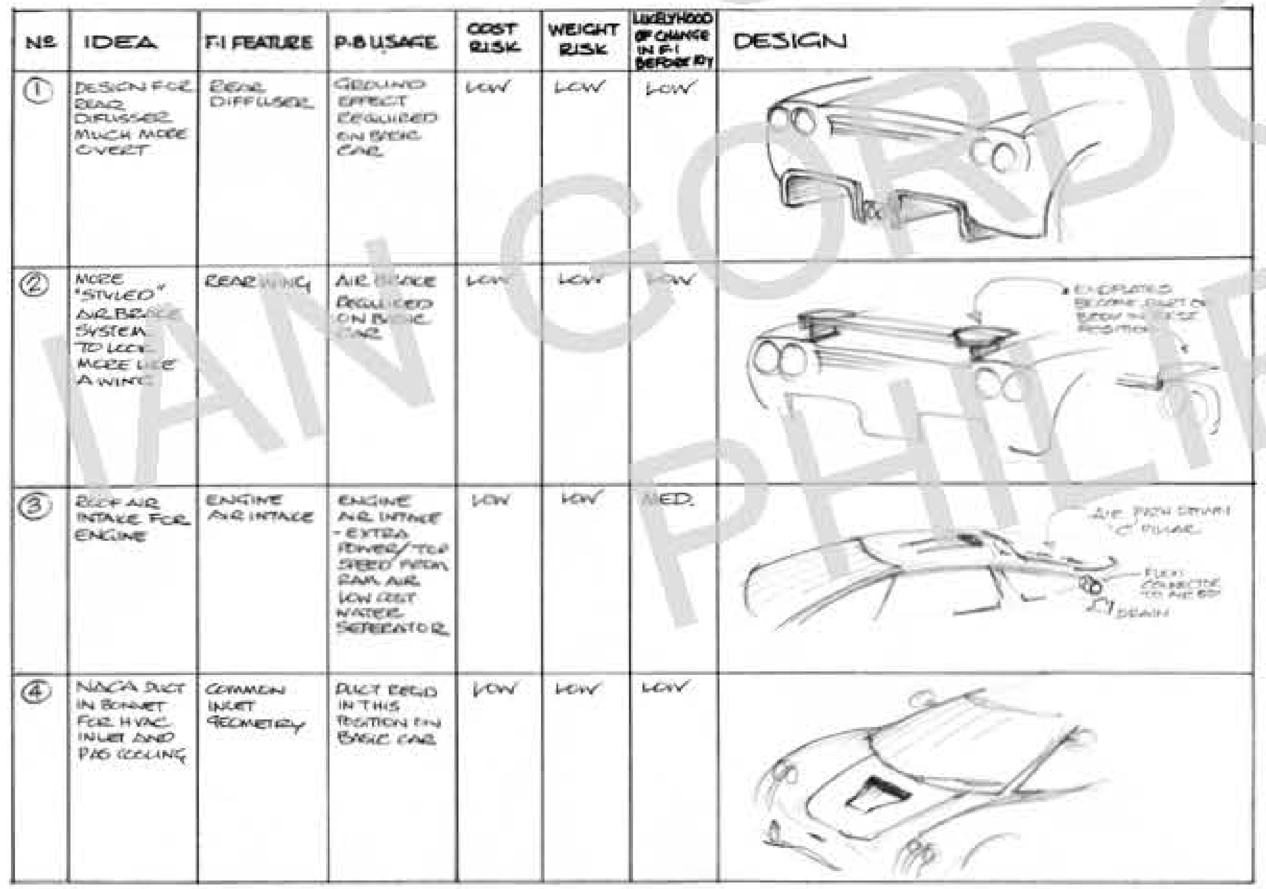
'Composite engineers Ben Geddes and Graham Halstead were part of my team and together we set about studying composite technologies from all around the world. Eventually we settled upon a press process that enabled us to make both monolithic and honeycomb panels in a much shorter time than the normal pre-preg system.

'I designed a layout for Project 8 – a mid-engined sports car using a central carbon tub with aluminium front and rear subframes that were mechanically attached. The tub was designed to be stiff enough to produce a Coupé and a Spider version from the same tooling.

'We went on to produce a half-scale monocoque and the design and packaging was looking very promising, but by this time McLaren Cars had lost all its direction and a lot of its best staff due to the lack of vision from the new management. I decided to leave and set up my own business with Creighton Brown.'

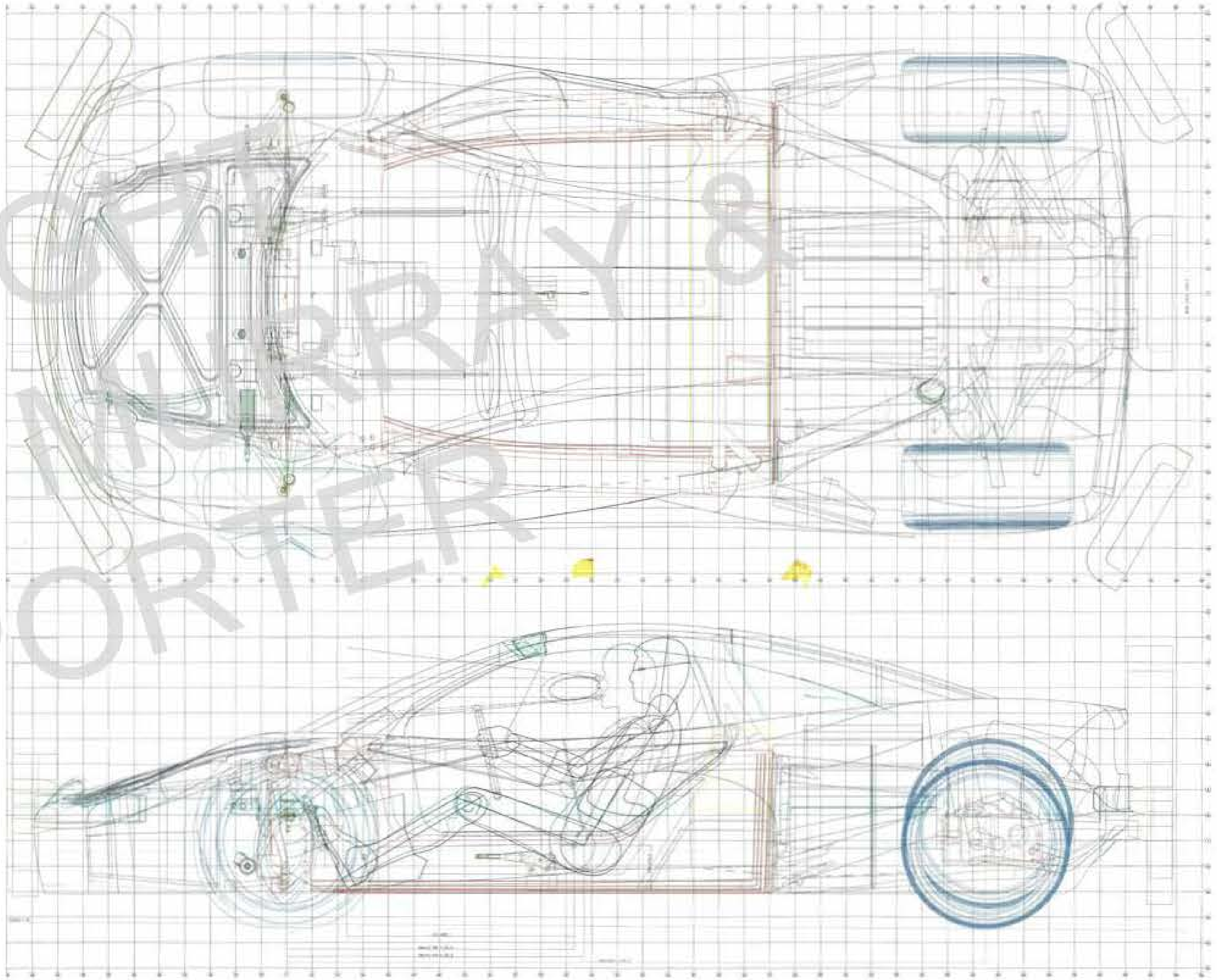


Nº	IDEA	F-1 FEATURE	P-8 USAGE	COST RISK	WEIGHT RISK	LIKELYHOOD OF CHANGE IN F-1 BEFORE R.Y.	DESIGN
⑤	"STYLED" RADIATOR INLETS TO MIMIC F-1 PODS	RADIATOR INLETS/SIDE PODS	RADIATOR INLETS WITH FORWARD FACING AREA AND BETTER PRESSURE DROP ACCROSS RADIATOR CORE	LOW	LOW	LOW	
⑥	ENGINE BAY CHIMNEYS ON REAR DECK	VARIOUS OUTLETS/ CHIMNEYS	ENGINE BAY CHIMNEYS REQUIRED ON BASIC CAR	LOW	LOW	LOW	"MECHANICAL" CHIMNEYS – TAKE CUES FROM F-1
⑦	BRAKE DUCT OPENINGS	BRAKE DUCTS	BRAKE DUCTS REQUIRED ON BASIC CAR	LOW	LOW	LOW	DUCT OPENINGS
⑧	EXHAUSTS TAILPIPES TO BE MORE "TECHNICAL"	EXHAUST EXITS	EXHAUST TAILPIPES	MED	MED	HIGH	



Nº	IDEA	F-1 FEATURE	P-8 USAGE	COST RISK	WEIGHT RISK	LIKELYHOOD OF CHANGE IN F-1 BEFORE R.Y.	DESIGN
①	DESIGN FOR REAR DIFFUSSER MUCH MORE OVERT	REAR DIFFUSER	GROUND EFFECT REQUIRED ON BASIC CAR	LOW	LOW	LOW	
②	MORE "STYLED" AIR BRAKE SYSTEM TO LOOK MORE LIKE A WING	REAR WING	AIR BRAKE REQUIRED ON BASIC CAR	LOW	LOW	LOW	ENDPLATES BECOME PART OF BODY IN REST POSITION
③	ROOF AIR INTAKE FOR ENGINE	ENGINE AIR INTAKE	ENGINE AIR INTAKE – EXTRA POWER/TOP SPEED FROM RAM AIR LOW COST WATER SEPERATOR	LOW	LOW	MED.	AIR PATH DOWN 'C' PILLAR FLEXI CONNECTOR TO AIR BOX DRAIN
④	NACA DUCT IN BONNET FOR HVAC INLET AND PAS COOLING	COMMON INLET GEOMETRY	DUCT REQD IN THIS POSITION ON BASIC CAR	LOW	LOW	LOW	

Above Gordon's sketches and notes on aerodynamics and styling cues for Project 8

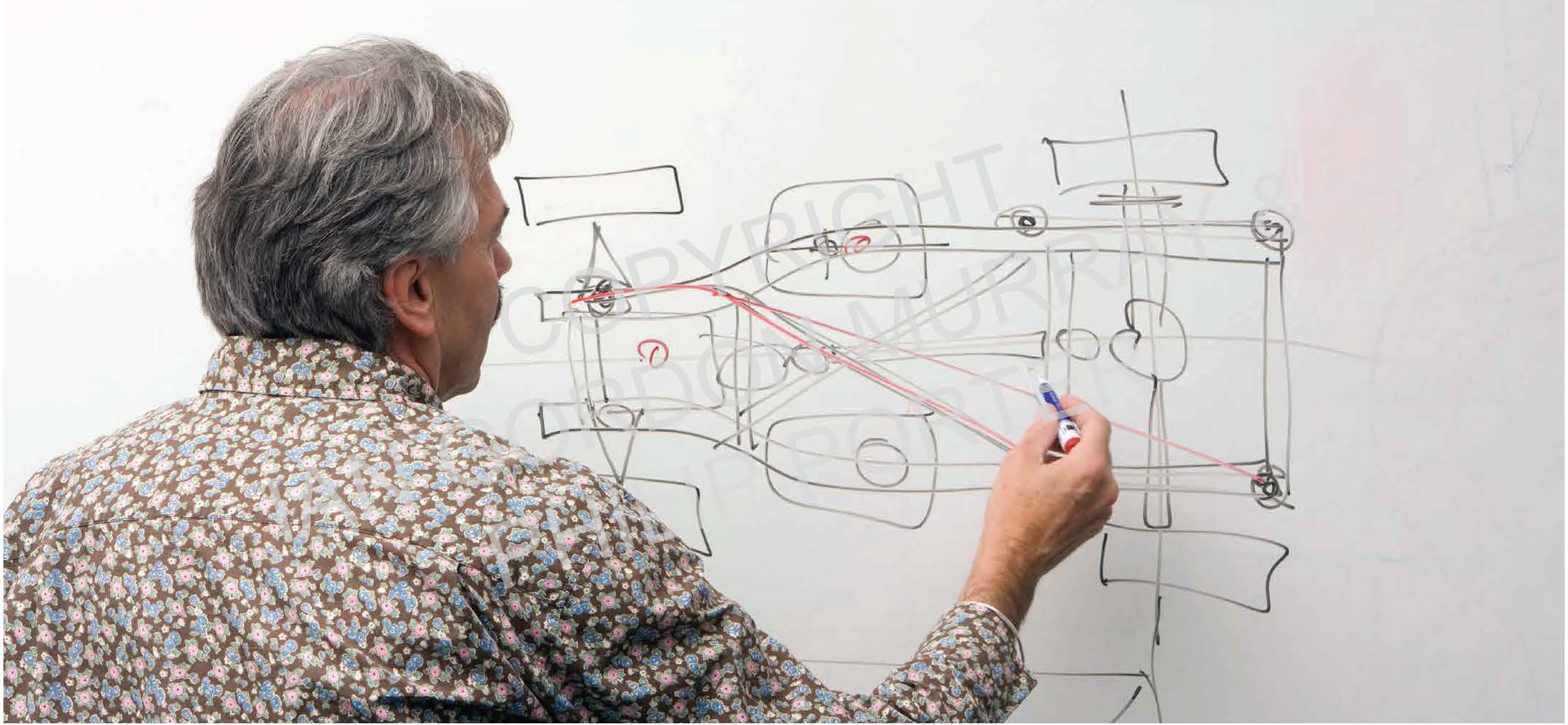


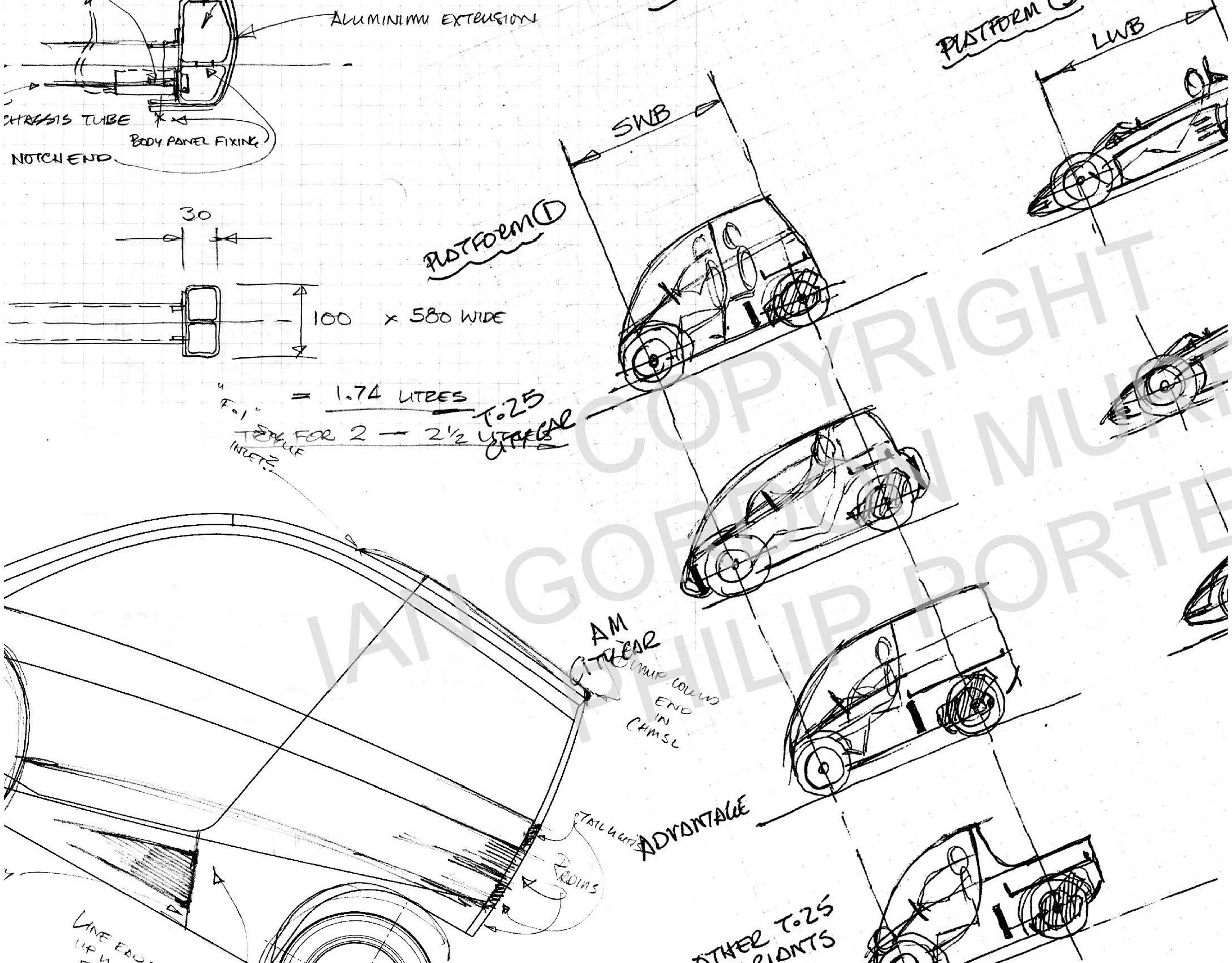
Above Packaging drawing for Project 8 – the idea was to have a relatively simple, central carbon tub with aluminium front and rear subframes to carry crash and suspension loads. The concept was resurrected for the MP4-12C many years later

GORDON MURRAY DESIGN YEARS

iSTREAM

2007-2017





T.25

THREE-SEAT CITY CAR

Gordon decided that he needed to build a physical entity using the radical new construction method, and chose the city car named Project 3 that he'd been working on at McLaren. He described it as being a 'logical start for an iStream demonstrator' because they'd already done about 12 months' work on it.

'When we'd perfected the manufacturing system, we would build one of these little cars and say, "There you go, crash it, drive it, do whatever you like with it. That's iStream; that's built with bonded composites." Half the team was working just on the manufacturing stuff and the other half was working on designing this city car.

'After we'd chosen the little central-drive, three-seater layout, we set about designing the car. I did a lot of benchmarking, and we built a couple of seating bucks to make absolutely sure the ergonomics were going to be good from an urban point of view. The car ended up with fantastic visibility all round, 360-degree visibility. In order to get to the central seat, we designed what we called the mono door – the whole canopy lifted up.

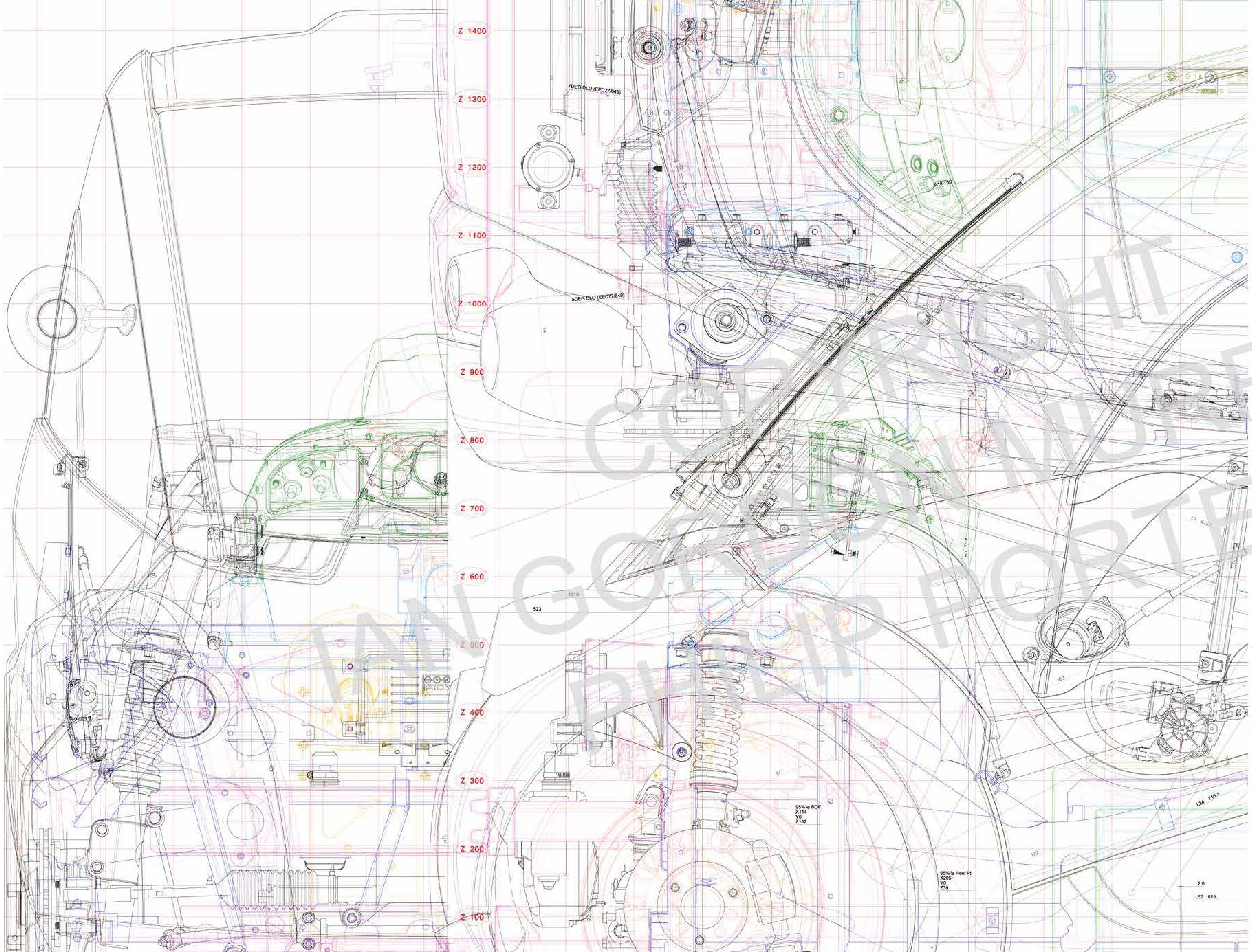
'We drove all the competition and they really were bad. Some of the so-called city cars had very bad over-shoulder, three-quarter visibility for cyclists coming past the car. The A-pillar was in the wrong place, and the B-pillar, and the scuttle was too high on some of them. We tried to fix all those things and made this little 600kg iStream car, which was so much fun to drive.

'We tested it for the first time on our test track at Dunsfold Aerodrome and I remember it just being a revelation. We took a Smart along as a comparison, and I remember our car just feeling so much better. We then did a lot of testing in Guildford traffic and around us here in Surrey, and it was just a magic thing.'

To make it even more magical, T.25 was designed so it could be supplied flat-packed. And, to reduce shipping costs, no fewer than 36 could be fitted into one container. Perhaps one could describe this as Gordon 'thinking inside the box'!

'We've still got the prototype, of course. It was just a funky little thing. In traffic, it was like driving a safe big motorcycle rather than a small motor car. We made sure it had all the stuff – it was a bit like designing the F1 all over again.

Left These are Gordon's early sketches for T.25 and an illustrated platform strategy



T.27

THREE-SEAT ELECTRIC CITY CAR

The T.27 project was particularly interesting for the team at Gordon Murray Design, because it was their first step into the world of electric cars and the experience would be invaluable for the company going forward. They worked very closely with Zytek, which designed and built the electric powertrain, and Vocis, which built the transmission. Even the battery was bespoke for the car.

'We got on very well with the Government agencies. In those days, it was the Technology Strategy Board. These days it's called Innovate UK. They were very supportive and played a part in saving the company after the 2008 worldwide economic collapse. Of course, they can see this bringing a lot of income and engineering kudos and manufacturing into the UK, and they've been very supportive over the years.

'The first thing they supported was T.27. So, we had a matched-funding grant to build an electric version of T.25 and do much more testing of iStream. We redid the styling a bit, making it a little bit nicer looking. We built several of those prototypes and went through the Euro NCAP crash tests. And we did some durability work and really moved the plot forward.

'The programme helped us in developing new patented ideas in some areas that were peripheral to iStream. We carried over our patented iLink rear suspension and we developed a new low-cost composite iStream battery-mounting system, which also managed all the crash loads.

'The T.27 drove very well and proved beyond any doubt that the way forward for electric vehicles was lightweighting, due to the positive effect of the virtual circle when beginning with a lightweight structure, smaller electric motor, smaller battery and therefore lighter running gear and components.

'Unfortunately, all recent electric vehicle designs suffer from the downward spiral – heavy structure, powerful motor, heavy battery and larger components. The T.27 was some 180kg lighter than the electric Smart fortwo.

'It really helped put iStream on the map. When new customers came in, we could say, 'Here's a car that's done the full frontal crash test, here's one that's done the pole test, here's one that's done the side impact…' And everything we had been saying in theory, on paper, proved to be absolutely true. People still can't believe when we build them prototypes how strong those little cars are, and the tiny amount of intrusion we get into the cabin from something like the pole test, which is an incredibly violent crash test.

'We let magazines drive T.27 – *Top Gear* did an article on it. We had some very, very good coverage and that again was basically the architecture of T.25 with the opening canopy.

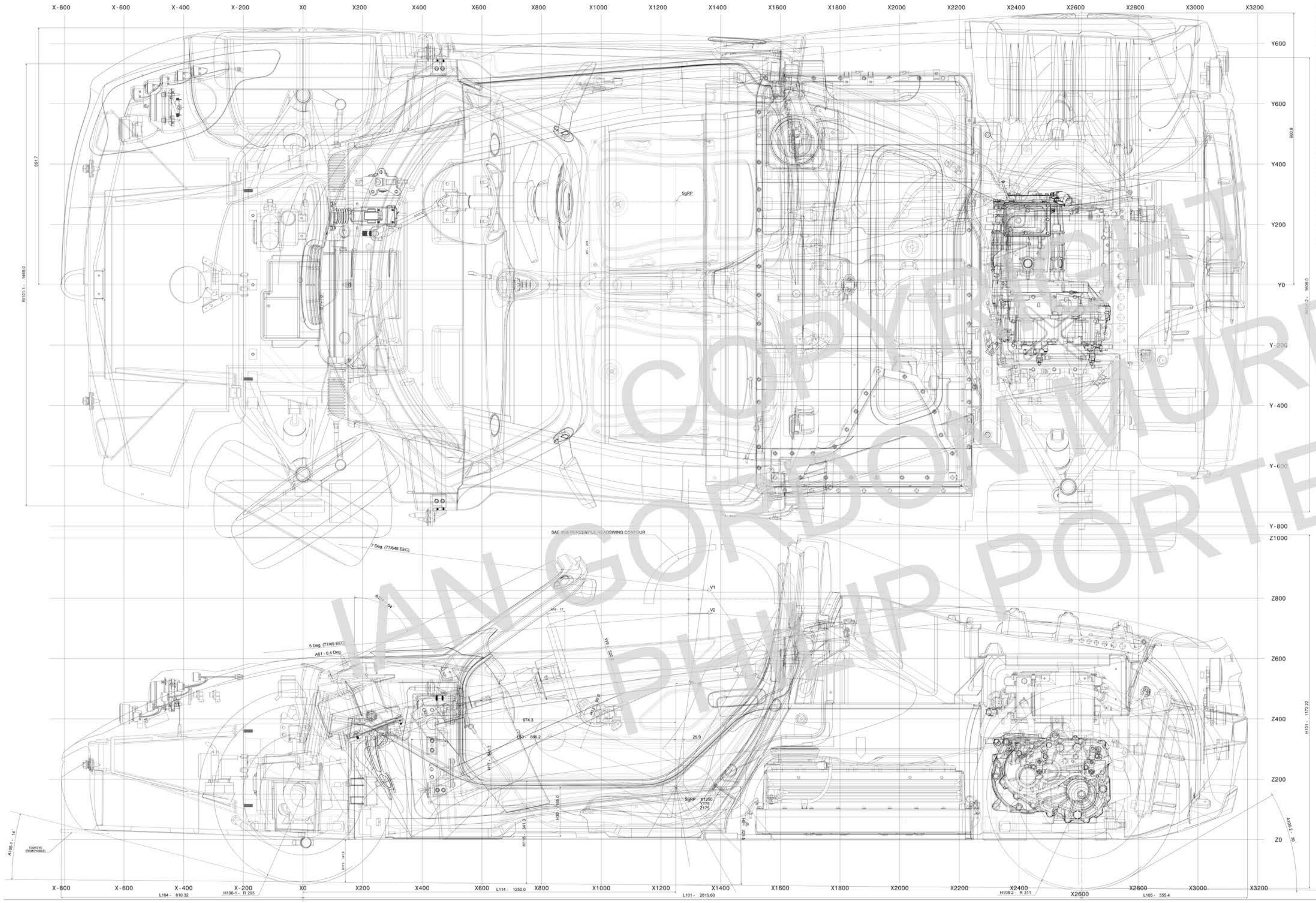
'We went back and took part in the RAC Future Car Challenge in 2011. With the T.27 we won the City Car class, the Electric class, and we won the competition overall against 11 OEMs. They've had to stop the event because the OEMs won't come any more.'

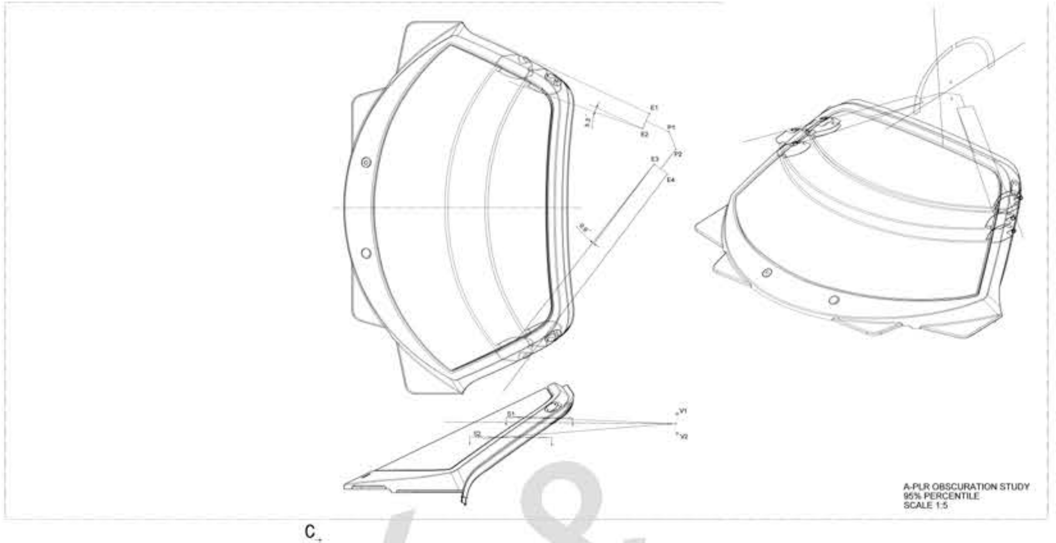
The 2013 event was indeed cancelled and there were rumours in the press that the OEMs were refusing to play ball again. Jim Holder of *Autocar* wrote: 'There were rumblings of… some manufacturers taking it so seriously that they came over weeks ahead of the event to map the route and optimise their settings and then dissatisfaction from said manufacturers when Gordon Murray rocked up in his T.25 and T.27 cars and usurped them.'

'The T.25 and T.27 designs both had great packaging,' says Gordon, 'accommodating three adults and good luggage space in a package smaller than a Smart fortwo. These two cars taught us a lot about small-car design, in particular crash performance, and the lessons learnt will stand us in good stead with iStream product design for many more years.'

Right In 2010, the T.25 won the City Car class and the ICE (Internal Combustion Engine) class in the RAC Brighton to London Future Car Challenge, achieving 97mpg. In 2011, the T.27 won the Electric class and took overall victory by some margin. For the drive from Brighton to London, it used a similar amount of energy to boiling two kettles!

Overleaf The T.27 iStream electric city car, which benefited from support from the British Government and did a fine job of raising the profile of iStream

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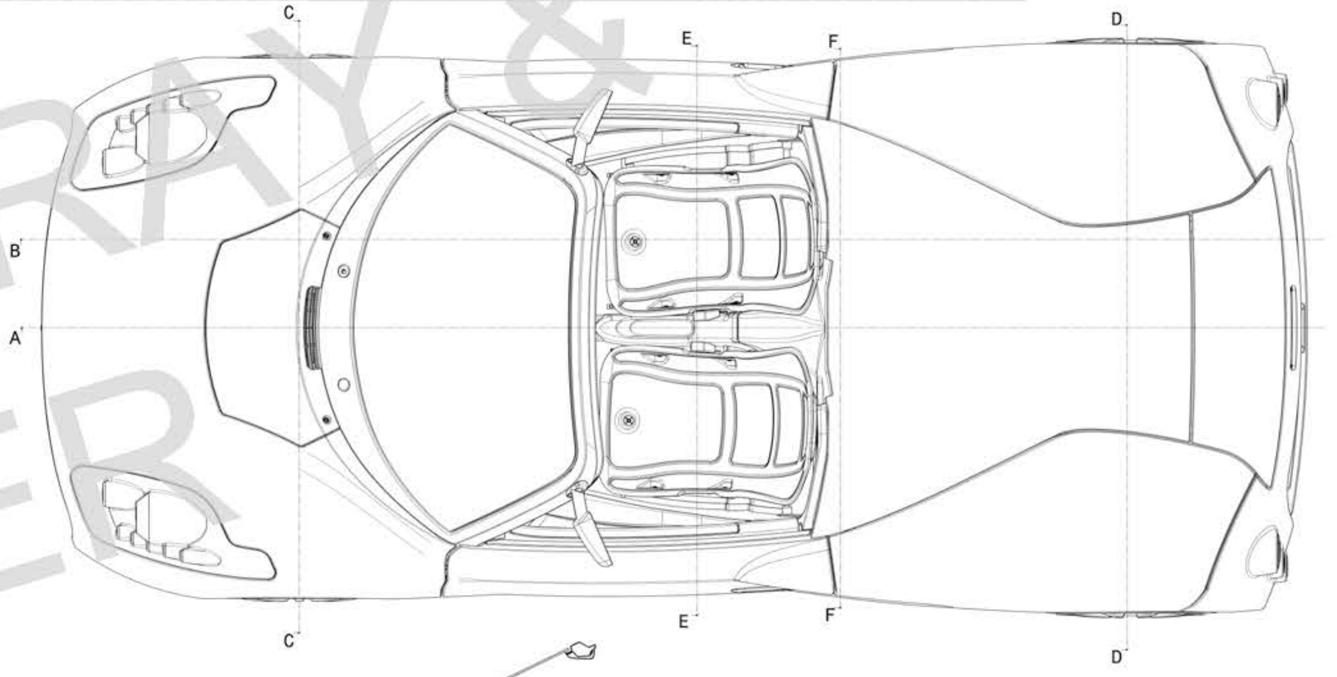

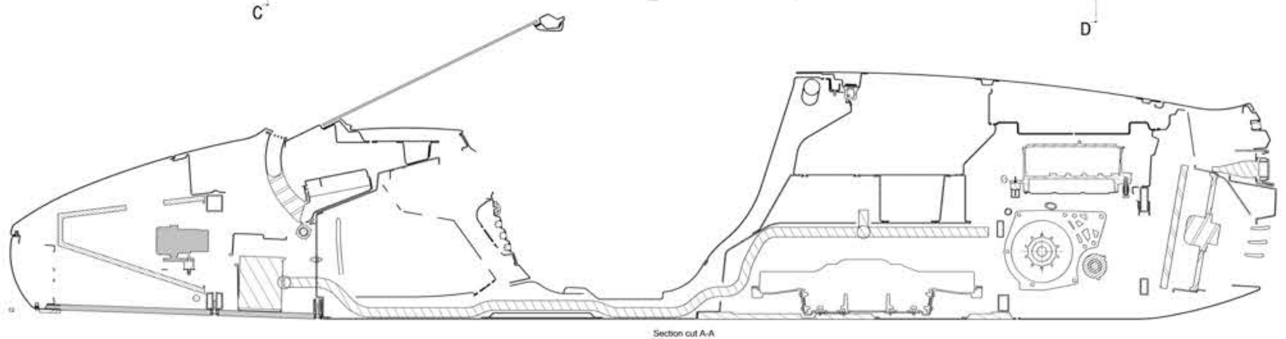
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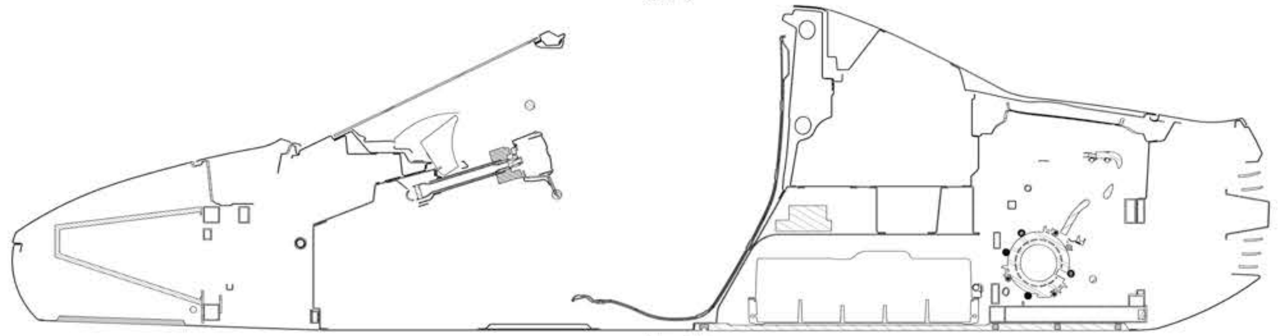
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'We said to them that the only thing we could do in time would be an open-top car. We couldn't do windows and stuff in that time. I got a team together and said, 'Look guys, I know it's not iStream, but it's really important to spread our name and our brand, and to have a really good relationship with Toray.'

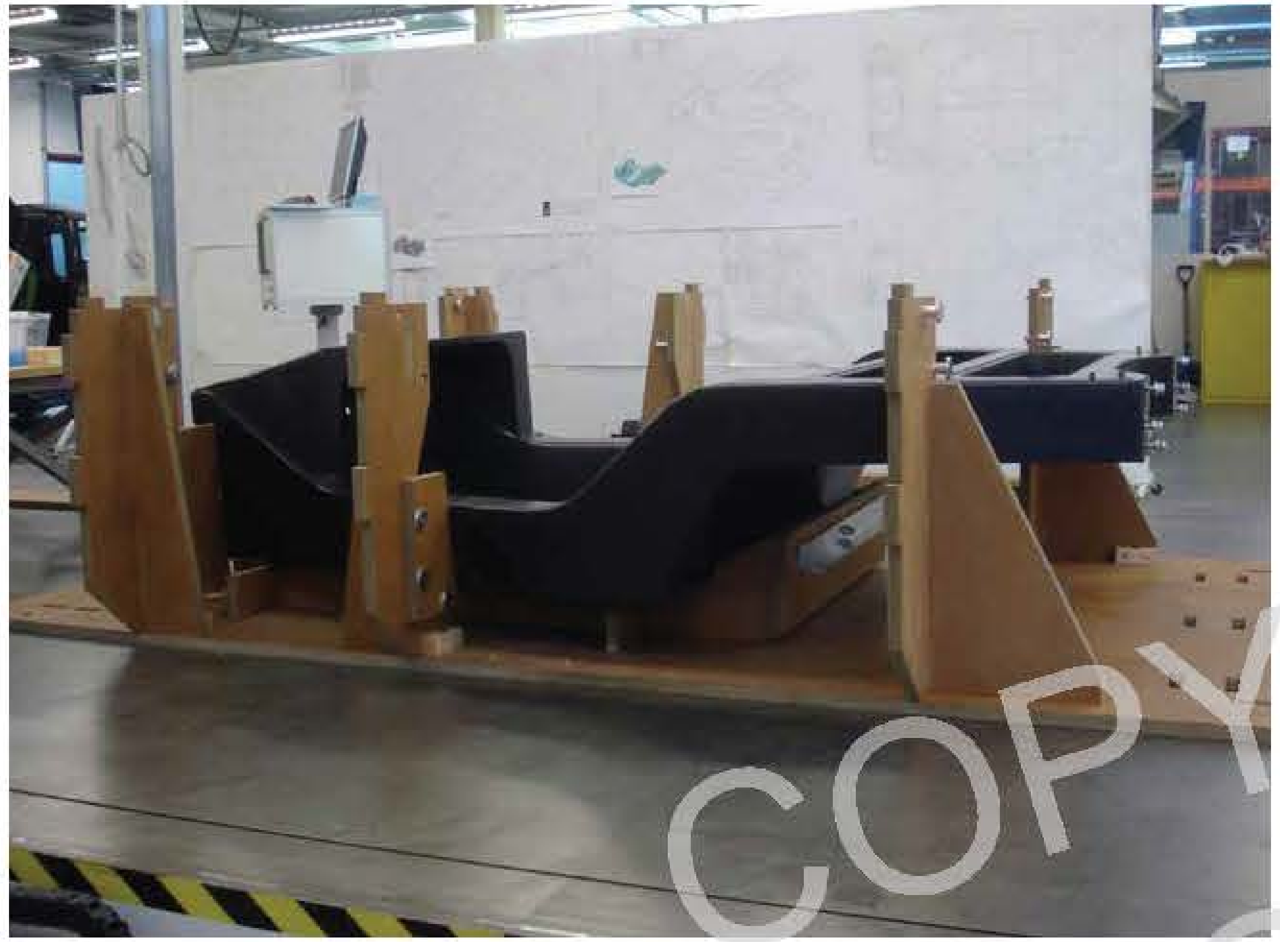
'We started on a monolithic carbon tub for the car because it best suited the raw materials, but this was new territory for us. The two most experienced composite designers in the company were Frank Coppuck and myself, and neither of us had designed a monolithic carbon chassis before.

'For the powertrain and battery, we carried over a Mitsubishi iMev vehicle, but we had to design the electrical interface with the chassis from scratch. The styling was done in-house by Zachary Seward with input and guidance from Kevin Richards and myself, and the team did a great job of designing the tooling and components for the body. The timescale meant that everything had to fit first time and it did!

'Both the design team and the prototyping team did a brilliant job of building this little thing, and it looks fantastic. It's all carbon and weighs 840kg with a 240kg battery, so the car itself weighs 600kg! We even made seats using their carbon.

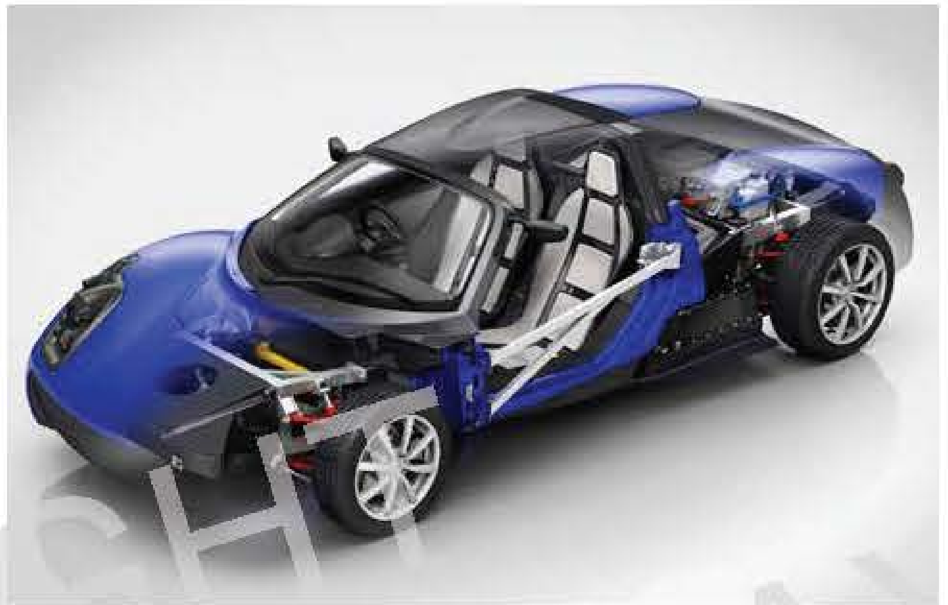
'And it's a sexy little open sports car. They wanted 'Designed by GMD' on the side, as Yamaha did. So that's like a Pininfarina/Bertone-type badge. Toray wanted a film made in the UK of the car running, which ate even further into the build time, but in the end we achieved the design, build and filming on schedule for T.32 to be flown out in time for their show. It was very, very good for us, and a fantastic exercise on speed and efficiency in the company.'

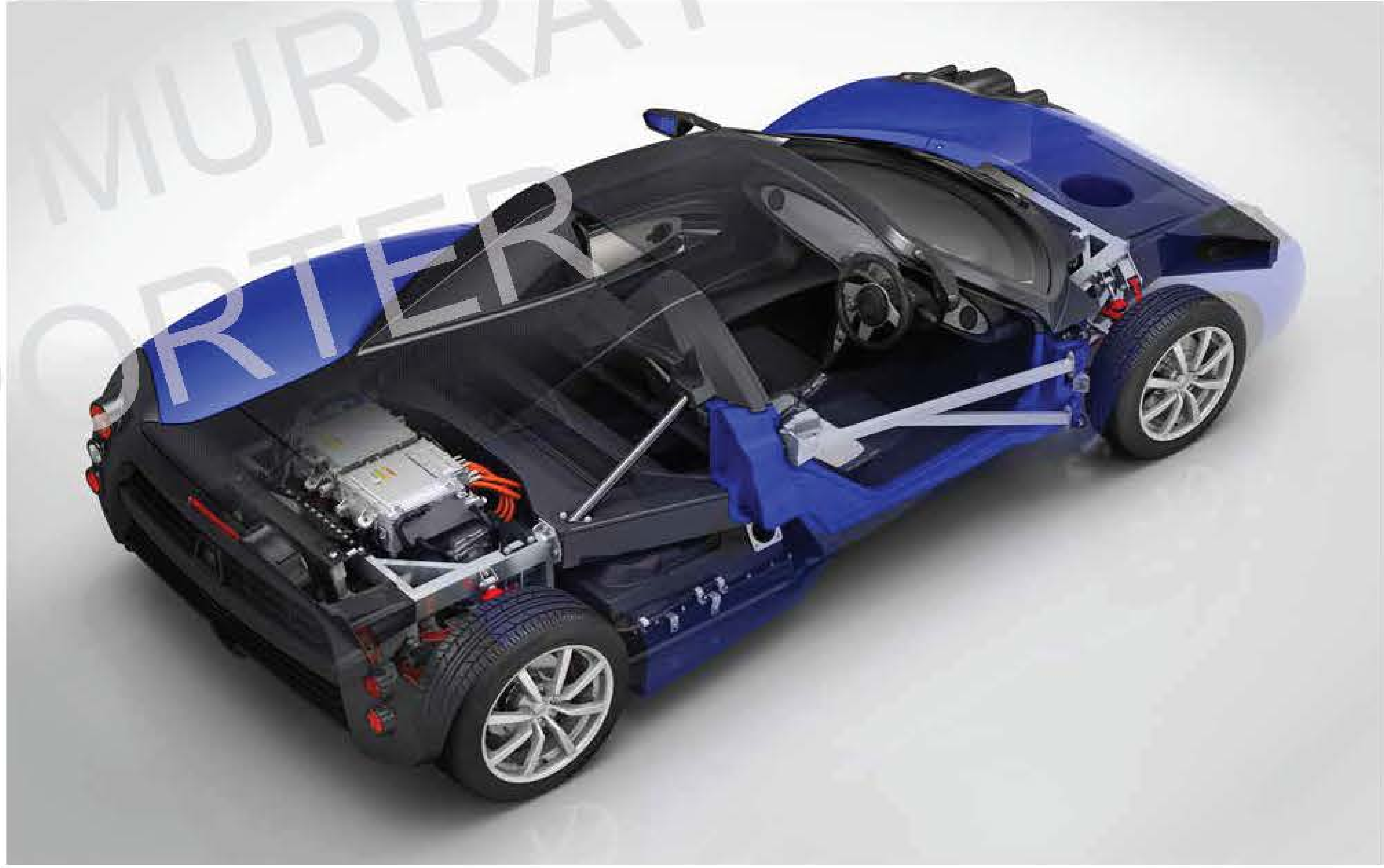
Christened by Toray as the Teewave AR.1, the car was a great hit at the Tokyo Motor Show and years later was still travelling the world and being used for events and displays. In November 2017, Toray graciously shipped the T.32 back to the UK for Gordon's One Formula 50th Anniversary event.



Top right An MDF jig was made for constructing the T.32 carbon fibre chassis

Bottom right A member of the GMD team, Paul Flood, is seen working on the jig





Above The T.32 was designed with a central carbon tub and separate aluminium subframes front and rear, in the same fashion as the earlier McLaren Cars Project 8

2013

YAMAHA MOTIVE.e T.26 SPECIFICATIONS

Weight	730kg
Engine	Zytek BEV
Chassis number	UGX-XE110-T3S-T26XP1

Design notes

First customer iStream vehicle, shown at the Tokyo Motor Show

Above Creative Director Kevin Richards (right) and Zac Seward with a clay scale model of T.26

Right The GMD team worked very closely with the Yamaha management during the development of the design for T.26

2015

YAMAHA T.40 SPECIFICATIONS

Weight	850kg
Engine	Yamaha 1-litre three-cylinder
Chassis numbers	GMD-ER03Z-*5S-T40X01 GMD-ER03Z-*5S-T40X02

Design notes

First announcement of iStream carbon at the Tokyo Motor Show

GVT OX

T.34

'The T.34 became known as the OX. For me, I think it's probably the most significant vehicle I've ever designed. People ask me which is the one I'm most proud of – it's probably the McLaren F1 because of what it achieved at Le Mans, and it's such a focus car. But the most significant vehicle, I think, which will go down in history, will be the OX. And I'm sure it's going to be a massive global success. The world's crying out for something like this.

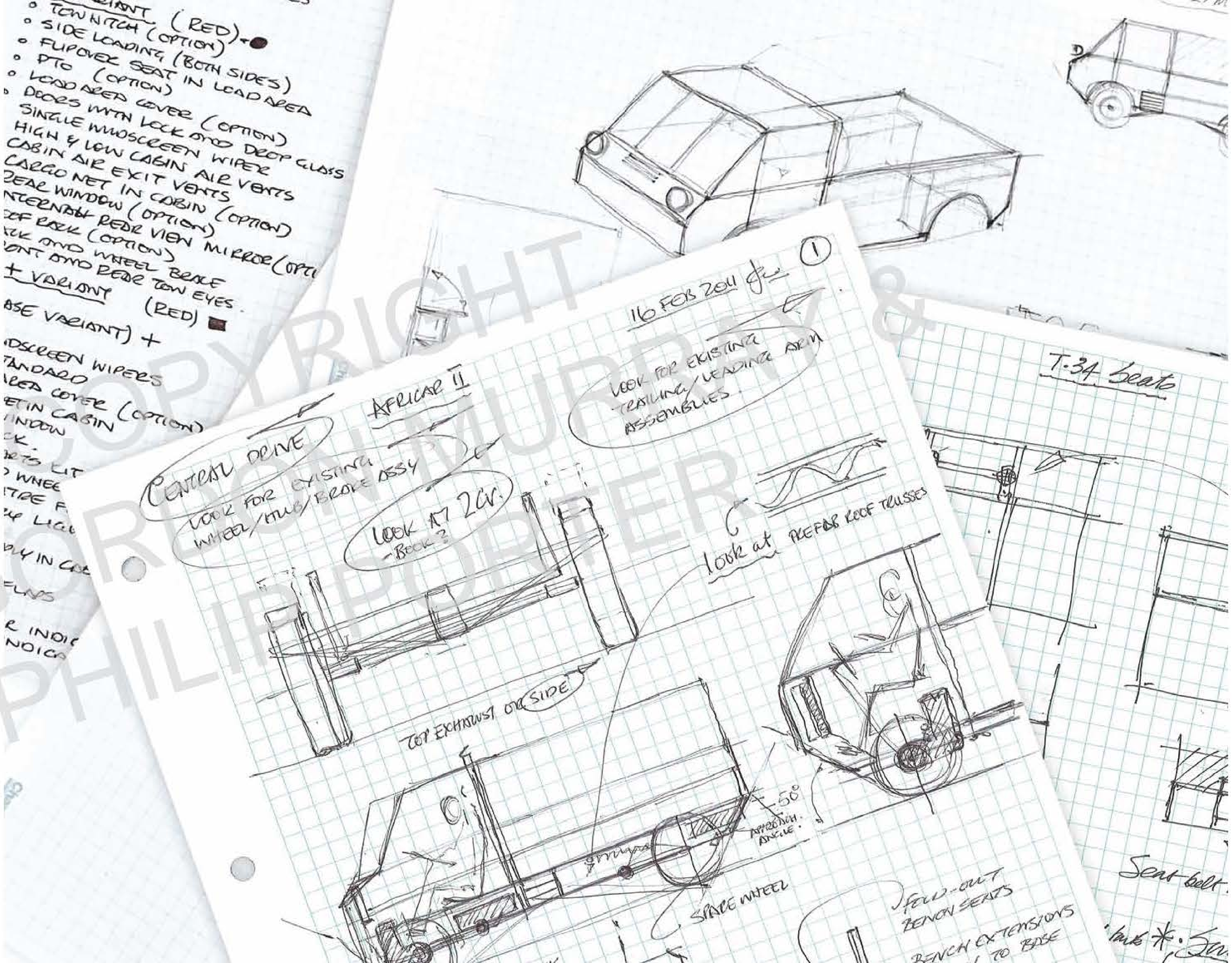
'It's a rather strange but humorous story. An entrepreneur and erstwhile businessman, Sir Torquil Norman, made all his money in toys and licensing toys around the world. He's long since retired and now well into his 80s. He came to see us in 2012. He was introduced by a mutual friend, Steve Cropley from *Autocar*. Steve brought him along and he explained that, since he'd retired, he was doing charitable work. He'd bought The Roundhouse in north London – that's been turned into a theatre in the middle, but all around it are workshops that train underprivileged people in all the theatrical skills. Not just acting but music, set design and everything. Evidently, they've put about 35,000 kids through there. Torquil invested and raised capital to restore the building. Quite rightly, he's very proud of that.

'His next big thing was mobility. In the 1980s, a guy called Tony Howarth felt someone should be making low-cost, lightweight, durable, basic transport for people in Africa who were walking 10 miles for water every day or for getting pregnant women to hospital, etc. He designed a vehicle with a steel chassis and plywood body, with both four-wheel and six-wheel versions, and called it the Africar. It was a really good idea but badly executed.'

Anthony Howarth was a British journalist and photographer. To prove the Africar and promote the concept, in 1984 he drove one 6,200 miles from Lapland in the Arctic to the Equator in Africa. The trip was filmed for a six-part TV series by Channel Four, which published a book entitled *Africar – The Development of a Car for Africa*. Just six vehicles were made before the company collapsed in 1988 with debts of £1.5m.

'The basic idea behind the Africar was excellent and ground-breaking but the vehicle packaging and engineering were poor, and the concept of local factories never really had any legs. Torquil's concept of flat-packing remedied that and hopefully the OX is better engineered!

Right Gordon's early concept sketches for the OX, a vehicle for Africa and Asia, and something totally different for GMD



Above OX design lead Jim Dowle driving the XP.2 prototype at the IDIADA proving grounds at Tarragona in Spain

'I basically took the Renault 4L formula and designed the OX. Except I even managed to have zero connection between the left- and right-hand sides – there are no anti-roll bars at all. I took my usual design – no anti-roll bars on the rear – and did a Rocket, if you like, and had none on the front as well.

'The proof of the pudding is you can now take an OX to a vicious 4x4 off-road test track and you just can't believe what it gets through. And the ride quality is better than any modern 4x4 with all its electronic stuff – much, much better ride quality. Ask anybody that's driven one. Nobody can believe it.

'Jim did a fantastic job with the flat-pack design; I worked very closely with him on that. We did several time-and-motion studies: we actually flat-packed the vehicles, unpacked them and packed them again. To save space and cost, it flat-packs into itself, which saves $200 of box. So it doesn't need a box: it actually folds into itself – goes down to just 600mm, the chassis height. Then the engine goes in a standard ISO crate, with all the bits that it needs like exhaust, battery, ECU and stuff. You can get six of them in a high cube shipping container, which is phenomenal when you think it's a full-size 3.5-ton truck.

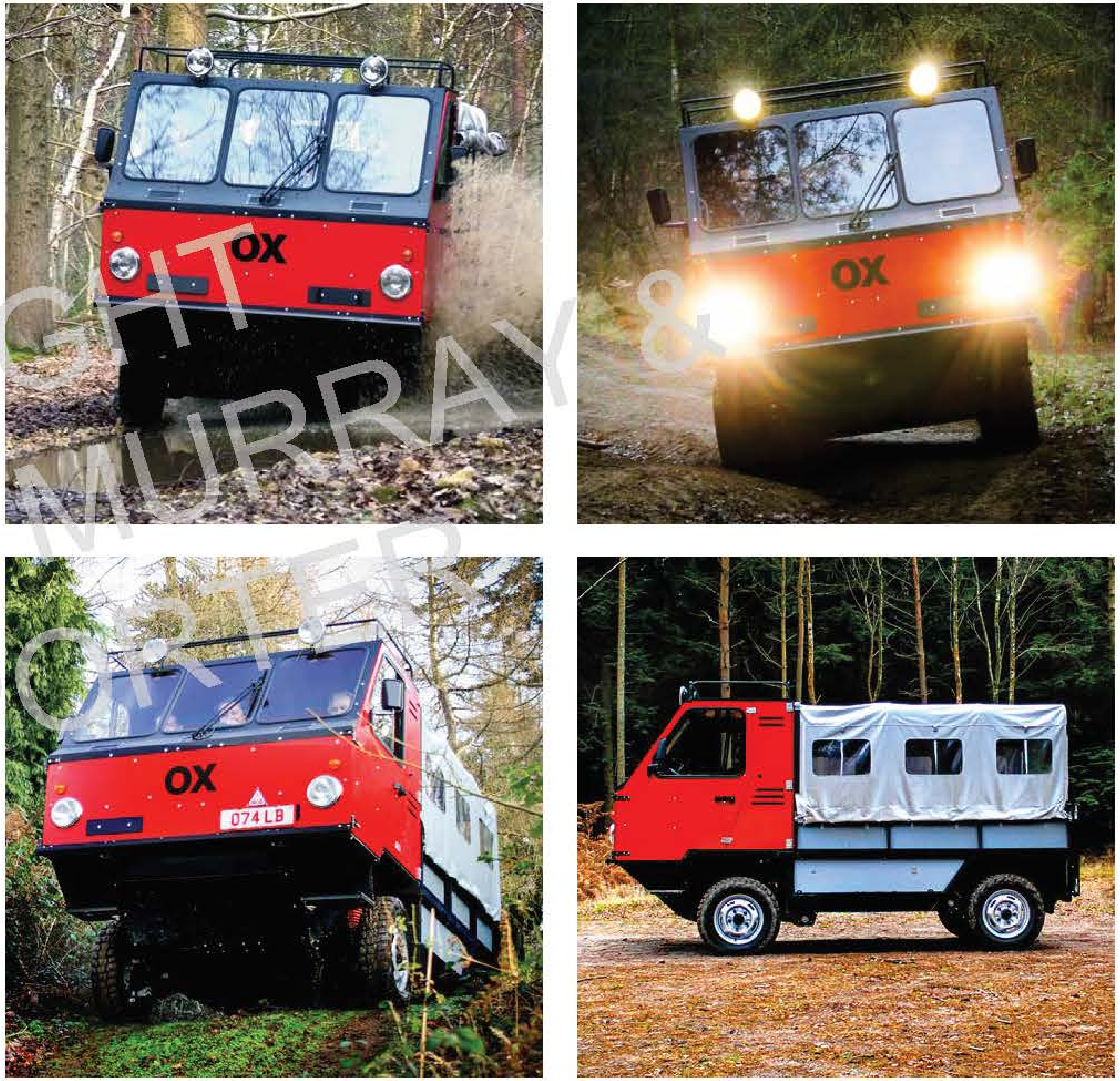
'We thought that as it's potentially going all around the world after Africa – because there's loads of places that need mobility – rather than write a manual on how to assemble it, everything is done with shapes and colour. So we have red triangles, blue squares, and the packages are marked with squares. We have a complete language-free set of assembly instructions for it.

'It comes with all the spanners that you need, and I even solved the problem of needing a crane to put in the engine. The engine and gearbox weighs a lot. It's a few hundred kilos, and you've got to lift that on to the engine mounts. So the bottom of the ISO crate that the engine comes in is a wooden fixture and that holds the engine and gearbox at exactly the right height for the chassis on a level piece of ground with no wheels fitted.

'When all the components are unpacked out of the chassis, six people can lift the chassis up. You take the engine-mounting caps off and you lift the chassis over the engine and it's in exactly the right place. It comes with its own jack – you jack it up, fit the wheels, and finish the assembly. There's no crane needed. Design is problem-solving, really. The flat-packing exercise was a really, really interesting challenge.

'We initially went to Longcross near Chobham and did some testing. There's an army test ground and it's got a fairly sedate off-road section, but it had mud puddles and quite steep inclines and things. We took the car there and immediately I drove it – and other people drove it – we could see that it had massive potential from a ride-quality point of view and a capability point of view, especially for just two-wheel drive. It sailed through the mud puddles, and up and down slopes on wet ground, so we knew it was going to be good.

'Subsequently, Jim himself actually drove down to IDIADA [in Spain] for some hot-weather testing in XP.2. At that stage, we didn't know what it was like on normal tarmac roads, so we drove it to IDIADA and back. We did 1,000 miles there and 1,000 miles back, and it didn't miss a beat. And of course, Jim got experience of it through towns, through traffic, on motorways. We took an engine development guy with us and, while we were climbing over the Pyrenees, he did some high-altitude mapping for the engine.



Above The first OX test, using the XP.1 prototype, took place at the Longcross Proving Grounds, a former Ministry of Defence facility near Chobham, Surrey

'Shell started talking to us, saying, 'What about doing a little city car with your iStream, but think into the future with all the other materials and see how light you can get that car. Rebody it to make it more aerodynamic.' A city car is a brick that's short, narrow and high. It's very difficult to make it aerodynamic.

'They told us to make it as aero as we could, as light as we could, and they'd give the engine to Goto and say to him, 'Use all your future technologies with ceramic coatings and stuff, and we'll develop fuel and lubricants, and let's just see in the real world what we can achieve. Then we'll do some calculations on life-cycle analysis. We'll get somebody to test the car completely independently of Shell and GMD, and measure all the figures.'

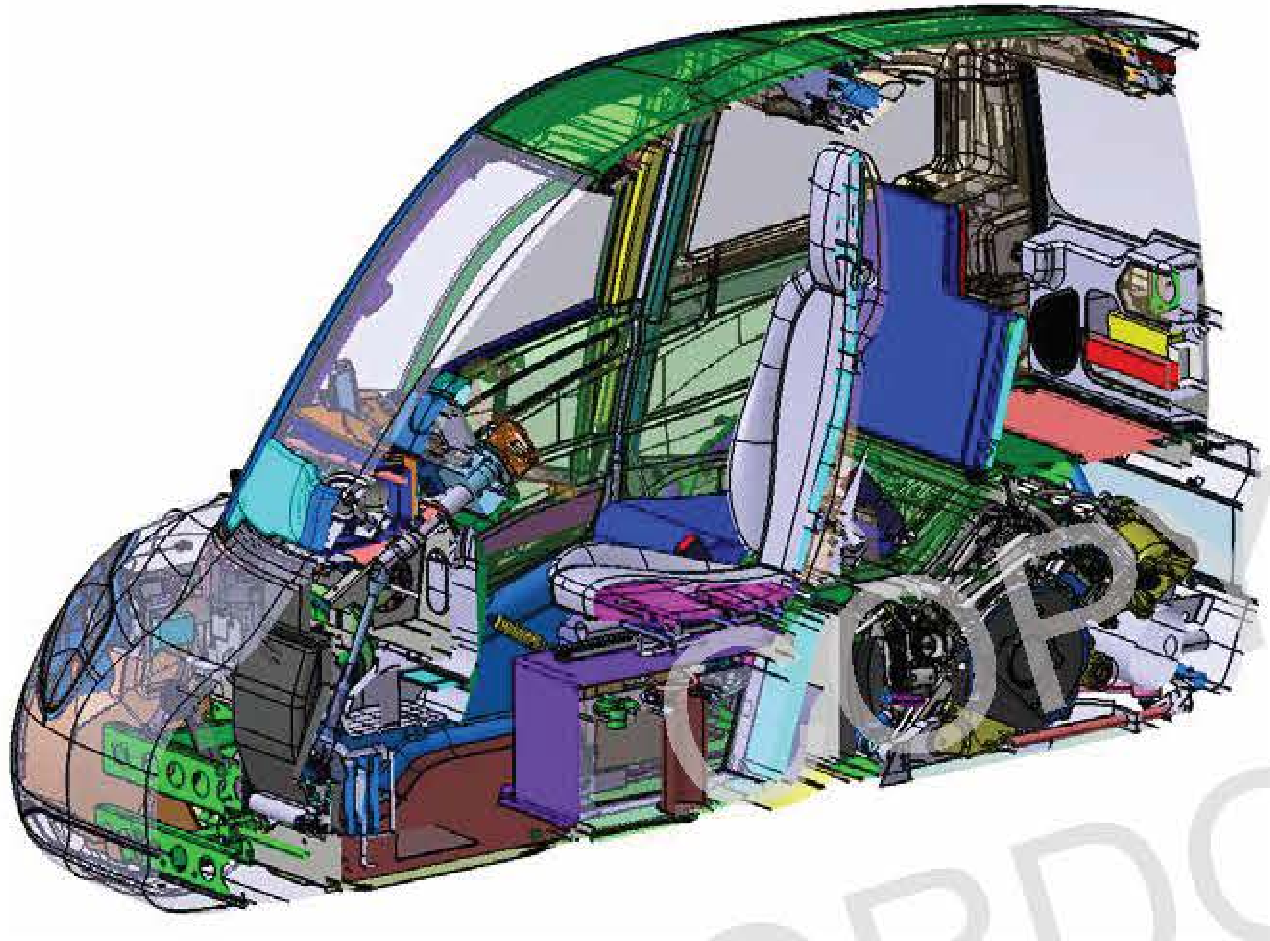
'All the Government figures are so cheated. Everybody cheats. Volkswagen got caught out with a blatant cheat but everybody cheats. The average difference between the Government fuel-consumption figures for internal-combustion cars and real-world figures is 26 percent – and hybrids are even worse. That's massive. People buy a car and in the pub they say, 'I've got a car that does 70 miles to the gallon', but they haven't. They've actually got a car that does 54 miles to the gallon.

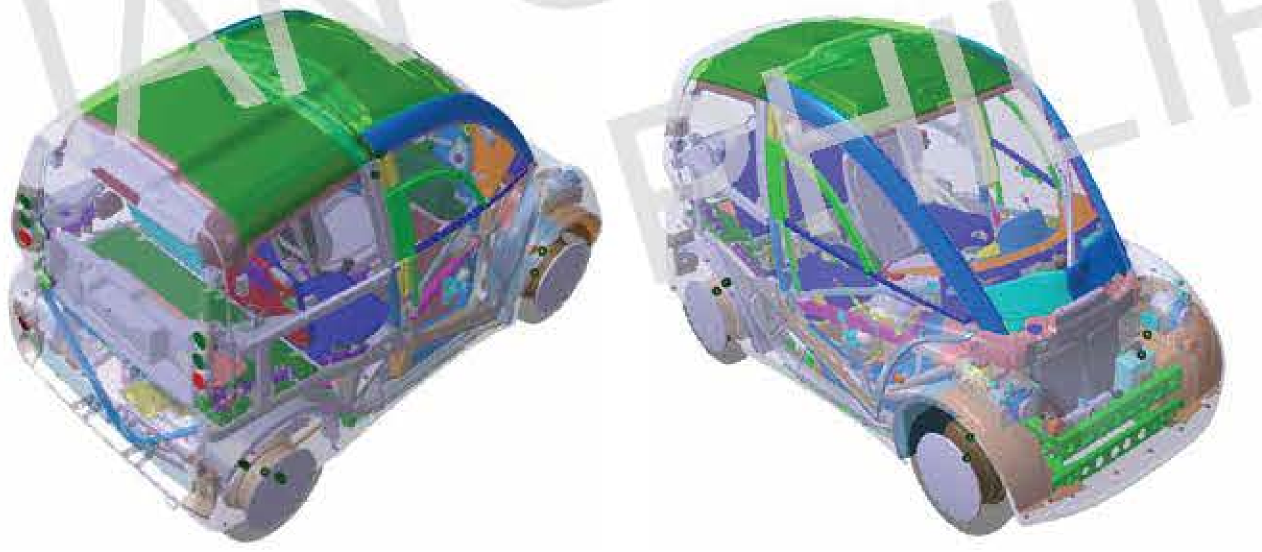
'With the budget we had and in their timescale, we couldn't design a new car, so we took T.25 and I said to Shell, 'T.25 is 630kg. That's already an incredibly optimised car. If you gave us a VW Polo and told us to take 100kg out of that – easy. But this car's already had every item scrutinised on it.' They said, 'Well, that's your problem. You said you were clever at saving weight. See what you can do.'

'We said, 'OK, it's 630kg. We'll try to take another 50kg out of it and get it down to 580kg.' I set the guys a task and said, 'You look at everything again: the brakes, the steering column, the seats – everything again.'

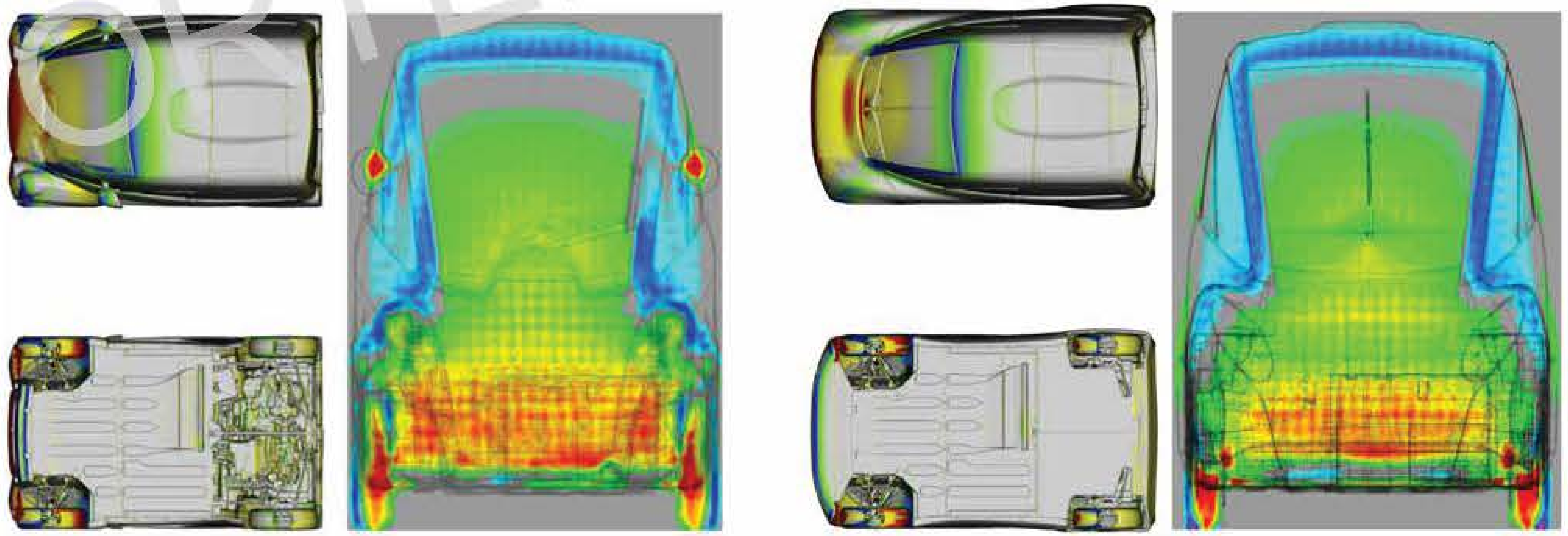
'Increasing the efficiency of an already optimised design is an extremely hard task and I had to challenge the team of young designers working on T.25s all the way through the process. We worked on every component from a design point of view, introduced new materials and revisited the aerodynamics. The aero side was the biggest lesson we all learnt because most designers write off aerodynamic detail in low-speed city cars, but in the case of T.25s the dramatic reduction in Cd we achieved played a large part in the overall efficiency of the car.

'We restyled it and faired-in the rear wheels, put discs on the front wheels, smoothed the underside even more and got the Cd from 0.39 down to 0.31. And we took 80kg out of it! Even we couldn't believe that.





Right The package for Project 'M' was based on GMD's T.25 city car



T.25

T.25s

Above A great amount of work was done on aerodynamic development for T.25s. The CFD work resulted in a reduction in drag coefficient from 0.39 to 0.31

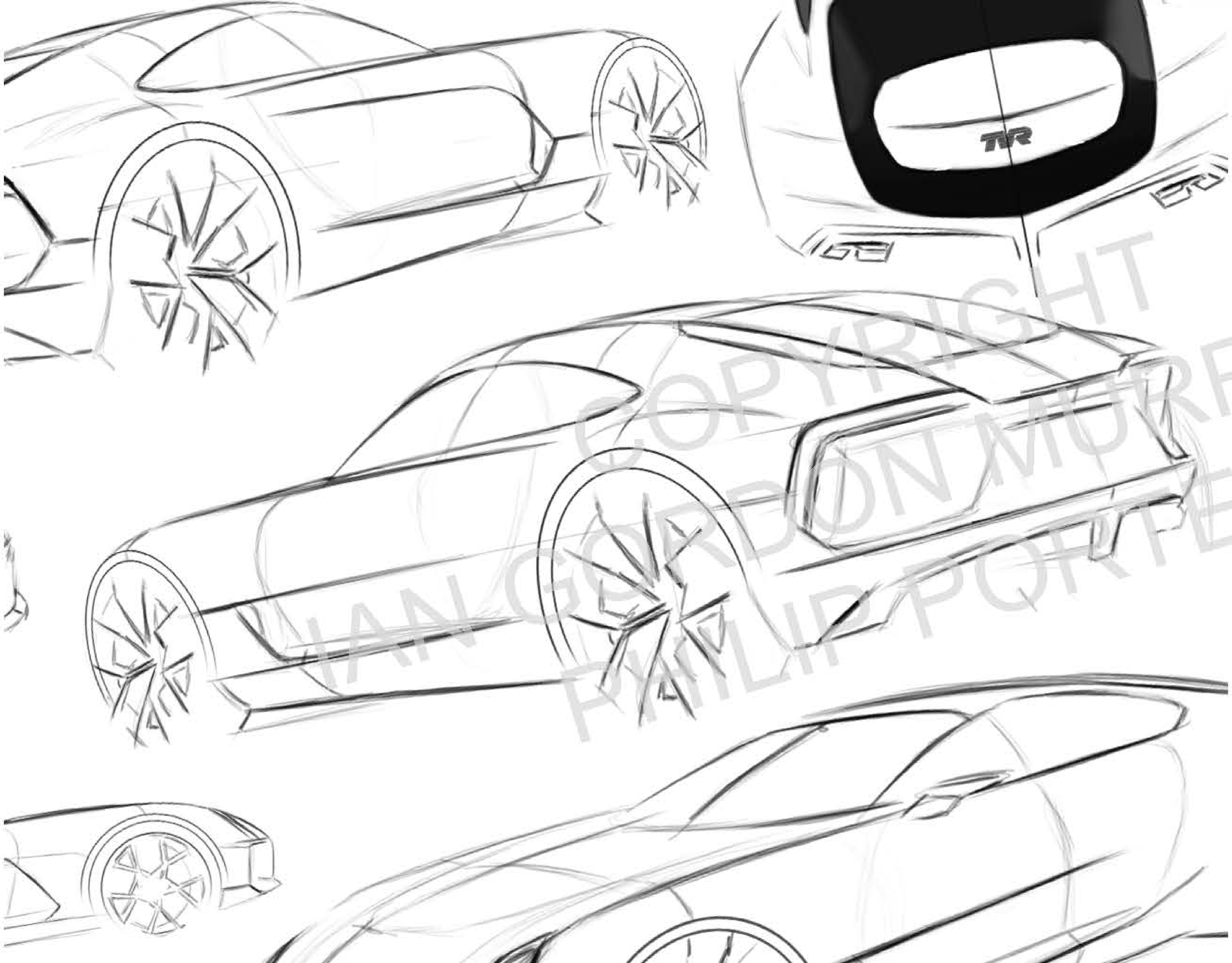
2017

TVR GRIFFITH T.37 SPECIFICATIONS

Weight	1,300kg
Engine	Ford 5-litre V8
Chassis number	XP.1

Design notes

First iStream production car



TVR GRIFFITH

T.37

‘A group of people led by Les Edgar bought the TVR brand a few years back. TVR has had a pretty chequered history spanning some 70 years, so I was pleased to be part of the brand resurrection.

‘The new owners came to see us right at the beginning, which was in 2014. They were very keen to launch something in 2017 to coincide with the anniversary. They came to see us, among a lot of other people, to look at manufacturing technology – exactly as Yamaha did. They trawled around, looking at and talking to a lot of people, and eventually came back to us and settled on iStream as the chosen way of making all future TVRs.

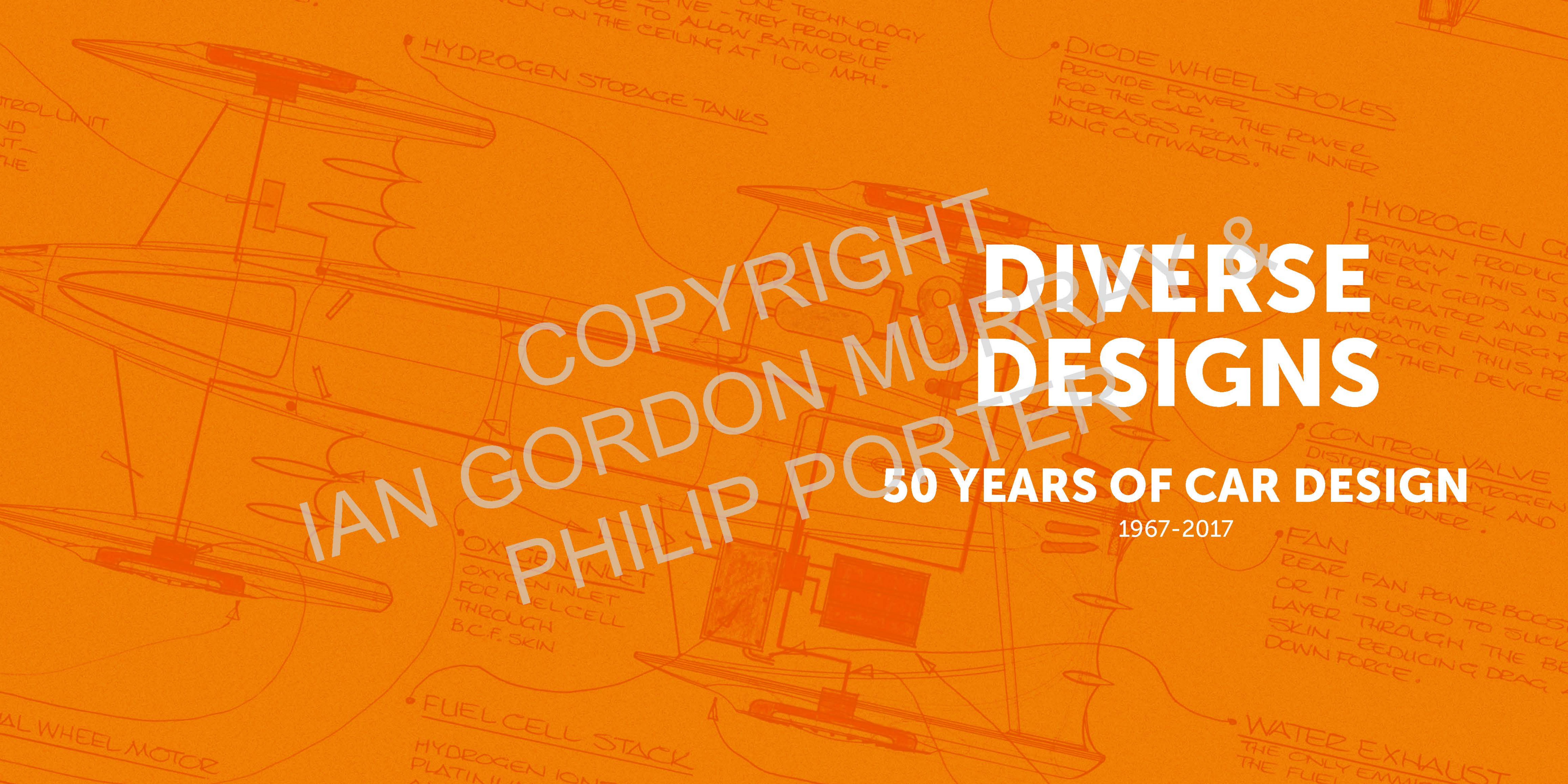
‘When I put it to our operations board and the rest of the senior management – that it was a chance to work with two British brands, because Cosworth are tuning the engine – using GMD and iStream, it was just too good an opportunity to miss.

‘From a GMD point of view, it was to be a complete operation – the brief from TVR was that the car was not to be too big, it had to have good everyday usability, good ergonomics and good visibility. That’s what a customer does. They write the spec and we’ve stuck to that religiously. We’ve made two, or even three, seating bucks, which they’ve signed off. We’ve bought a lot of cars to benchmark. We’ve all driven them, we’ve all sat in them, got in and out of them, and we’ve benchmarked it against good cars and bad cars.

‘We’ve got to do all the engineering design, all the styling – interior styling, exterior styling – we’re designing the production factory, which will be in Wales, and we’re helping them with inputs for the business plan. So, we are doing a “turn-key” for them – basically everything.

‘The styling process was relatively fast. We did the usual small clay models and worked up from there. We did a 40 percent model in clay and we really signed it off at that scale. That was scanned and surfaced, and then we cut a full-sized model. Once we cut the full-size model, the car didn’t change very much. The way we work, and the way I’ve always worked on the F1 programme and every road-car programme is, we do not style the car first. It’s an interesting process – all the engineering, styling, homologation and aerodynamics are done together.

Left: Early concept sketches for T37, which would be known publicly as the TVR Griffith, reviving an iconic TVR model name



DIVERSE DESIGNS

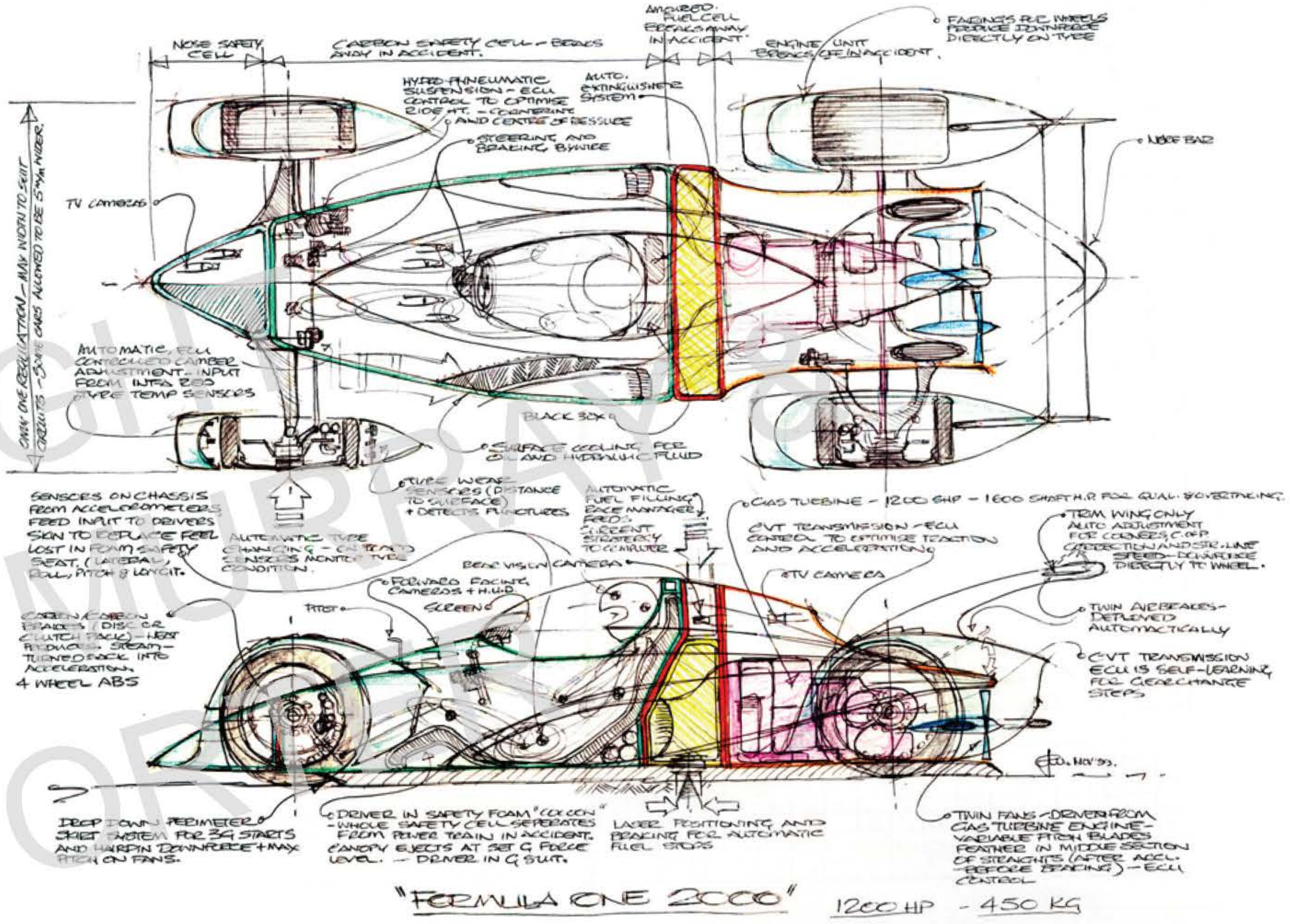
50 YEARS OF CAR DESIGN

1967-2017

PROJECT 4 (1+1 F1 CAR)

1998-'99

McLaren were the first team to produce a two-seater Formula 1 car for publicity purposes. Gordon brought his tandem design, the LCC Rocket, into work and handed it to Barry Lett and the team.


NOSE SAFETY CELL
CARBON SAFETY CELL – BREAKS AWAY IN ACCIDENT.
ARMOURED FUEL CELL BREAKS AWAY IN ACCIDENT
ENGINE UNIT BREAKS OFF IN ACCIDENT
FAIRINGS FOR WHEELS PRODUCE DOWNFORCE DIRECTLY ON TYRE
HYDRO-PNEUMATIC SUSPENSION – ECU CONTROL TO OPTIMISE RIDE HT. – CORNERING AND CENTRE OF PRESSURE
AUTO. EXTINGUISHER SYSTEM
STEERING AND BRAKING BY WIRE
NERF BAR
TV CAMERAS
ONLY ONE REGULATION – MAX WIDTH TO SUIT CIRCUITS – SOME CARS ALLOWED TO BE 5% WIDER.
AUTOMATIC, ECU CONTROLLED CAMBER ADJUSTMENT. INPUT FROM INFRA RED TYRE TEMP SENSORS
BLACK BOX
SURFACE COOLING FOR OIL AND HYDRAULIC FLUID
SENSORS ON CHASSIS FROM ACCELEROMETERS FEED INPUT TO DRIVERS SKIN TO REPLACE FEEL LOST IN FOAM SAFETY SEAT. (LATERAL, ROLL, PITCH & LONGIT.
TYRE WEAR SENSORS (DISTANCE TO SURFACE) + DETECTS PUNCTURES
AUTOMATIC TYRE CHANGING – ON BOARD SENSORS MONITOR TYRE CONDITION.
AUTOMATIC FUEL FILLING RACE MANAGER FEEDS CURRENT STRATEGY TO COMPUTER
GAS TURBINE – 1200 SHP – 1600 SHAFT H.P FOR QUAL. & OVERTAKING.
CVT TRANSMISSION – ECU CONTROL TO OPTIMISE TRACTION AND ACCELERATION
TRIM WING ONLY AUTO ADJUSTMENT FOR CORNERS, C.OF P. CORRECTION AND STR. LINE SPEED – DOWNFORCE DIRECTLY TO WHEEL.
REAR VISION CAMERA
TV CAMERA
FORWARD FACING CAMERAS + H.U.D.
SCREEN
PITOT
CARBON/CARBON BRAKES (DISC OR CLUTCH PACK) – HEAT PRODUCES STEAM – TURNED BACK INTO ACCELERATION.
4 WHEEL ABS
TWIN AIRBRAKES – DEPLOYED AUTOMATICALLY
CVT TRANSMISSION ECU IS SELF-LEARNING FOR GEARCHANGE STEPS
G.M. Nov '93.
DROP DOWN PERIMETER SKIRT SYSTEM FOR 3G STARTS AND HAIRPIN DOWNFORCE + MAX PITCH ON FANS.
DRIVER IN SAFETY FOAM "COCOON" – WHOLE SAFETY CELL SEPERATES FROM POWER TRAIN IN ACCIDENT. CANOPY EJECTS AT SET G FORCE LEVEL. – DRIVER IN G SUIT.
LASER POSITIONING AND BRAKING FOR AUTOMATIC FUEL STOPS
TWIN FANS – DRIVEN FROM GAS TURBINE ENGINE – VARIABLE PITCH BLADES FEATHER IN MIDDLE SECTION OF STRAIGHTS (AFTER ACCL. – BEFORE BRAKING) – ECU CONTROL
"FORMULA ONE 2000"
1200 HP – 450 KG

F1 2000

2000

'When 50 years of [World Championship] Formula 1 was being celebrated in 2000, *Motor Sport* approached me and said, "We'd like to celebrate 50 years by having you think, if there were no regulations, what a Formula 1 car would look like now, and going forward. We'll print it inside the magazine and show it on the cover.

'I said, "Look, I haven't got much time. If you don't mind just a ballpoint, coloured-in drawing – I can't sit and do a fine drawing, but if you don't mind just a sketch." And they said, "No, no, that's fine." So I went absolutely to town. I did this twin-fan car with everything I'd always wanted to do: g-suit for the cornering speeds and self-positioning for pit stops, faired-in wheels, and, and, and… It was this really rocket-looking thing.'

BATMOBILE

2010

‘We’re at work at GMD. It’s 2010 so we’ve been going three years. I get an email that says, ‘We’re going to do a new live Batman show, and we think it’s about time the Batmobile was brought right up to date with technology and materials, and we think you are the guy to design it. Please let me know.’ And I thought, ‘Yeah, that’s one of my mates for sure.’ It was just the way it was written; it was so matter of fact. ‘We’d like a new Batmobile and we think you should design it.’ It read like that. I didn’t even answer it because I thought it was one of my mates taking the Mickey.

‘Then I got another one, saying the same thing. And I thought, ‘Oh, OK.’ We phoned the bloke up, or emailed him back, and it was for real! It was this guy Nick, who’d got permission from Warner Brothers to do the world’s first *Batman Live*, which is what the show was called. A show that, over the next five years, he was going to take around the world.

‘I got the management together at work, and I said, ‘Guys, if they’ll let it be known that I designed the car, it’s good for the brand. It’ll filter through into different segments and be seen by the public, and it might be some fun to do. What do you think?’ And they said, ‘Yeah, as long as we can do it for what they’re going to pay us. Can’t spend much time…’ I said, ‘No, no. I won’t involve anybody else. I’ll do everything myself. I’ll do it quickly on the drawing board. And that’ll be it.’

‘Kev Richards, my creative director, got involved because he had one surfacer there who took my drawing. It had to be surfaced for them to cut the model. So Kev and I basically did it together. I loved it because I could just let my imagination run wild. I had a couple of meetings with the guys, and Nick and his guys, and he said, ‘Yeah, do anything you like! It’s just got to be future materials, even if maybe they don’t exist yet, and the next technology.’

‘They gave me the scenario where it comes on to the stage and spins round and stops. They wanted flames coming out the back, but they couldn’t have real flames. And they wanted the wheels to look like they were going round, but they couldn’t really be. They wanted the cockpit to open because Batman and Robin had to get out, and get back in again. It had to turn round and shoot off, and that’s all it had to do.

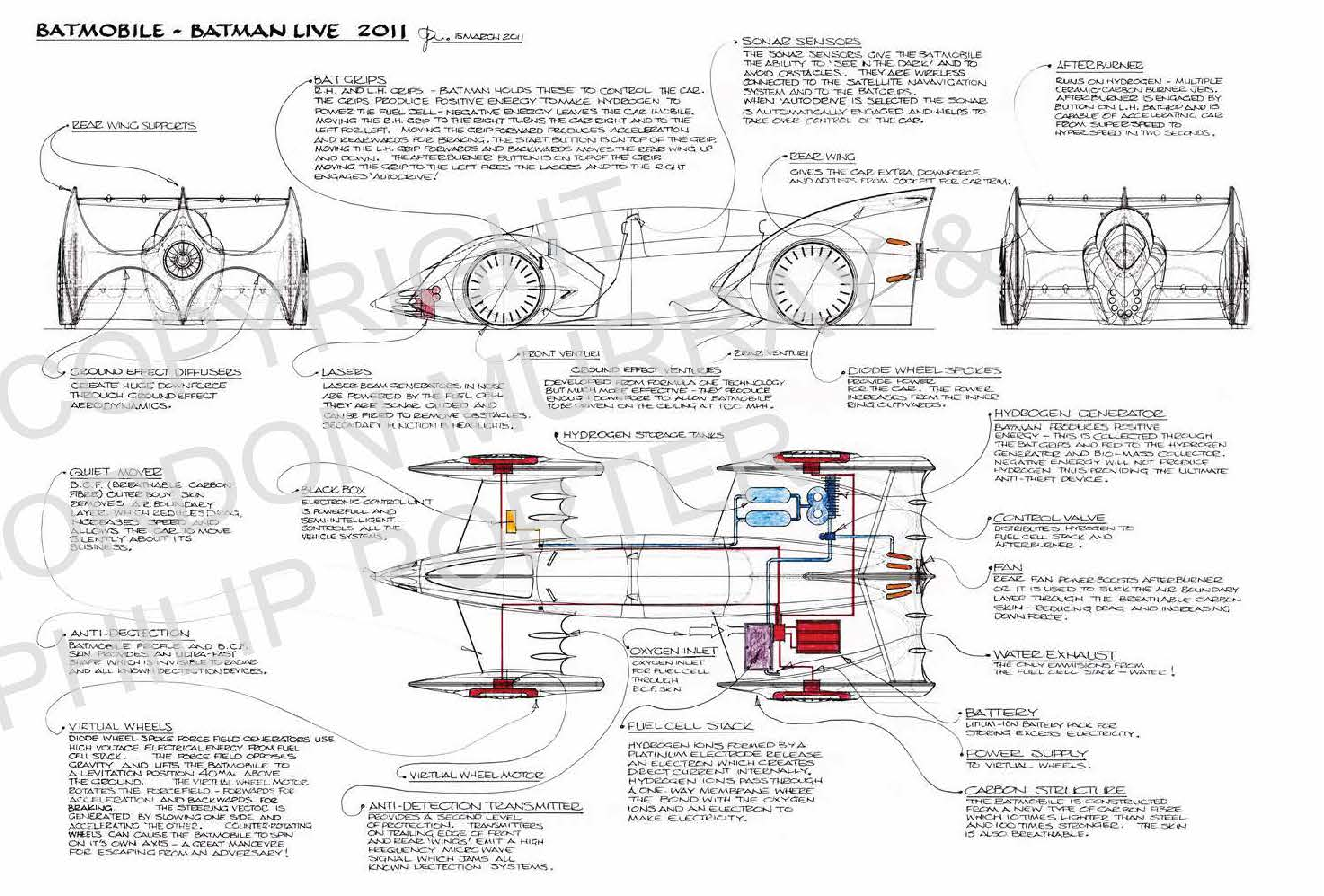
‘So I just went bananas. It runs on good energy and bad energy, it’s got a hydrogen fuel cell, it’s got a breathable carbon fibre body, and it levitates on laser wheels or something, and I just let my imagination run wild. It was perfect for me.

‘For the flames out the back, we got a red lamp and a fan and a smoke generator. You can be 20ft from it and you’d swear it was real flames. This 10ft flame comes out the back. I made the wheels go round with LED laser lights that went round and changed colour for different amounts of levitation energy, and all that sort of stuff!

‘We worked with a company in Wimbledon that actually made the model. Kev and I went down there a couple of times while they were building it to make sure they could read the drawings and stuff. They were really fantastic people. Fun to work with and, sure enough, they made this super-modern Batmobile. They had a launch of the show and the Batmobile in London, where they actually had television there, and they took the black cover off the car, lifted it up and with all the lights working and the wheels going… It was brilliant. I was interviewed. I felt like I’d designed a real car!

‘The *Daily Telegraph* reporter said, ‘How does the levitation work?’ And I was saying, ‘Well, it doesn’t really levitate.’ Not satisfied with that, he said, ‘No, but you’ve explained in the programme how it works.’

‘Oh, OK. The levitation works with this positive energy force-field…’



BATMOBILE - BATMAN LIVE 2011 15 MARCH 2011

REAR WING SUPPORTS

BAT GRIPS
R.H. AND L.H. GRIPS - BATMAN HOLDS THESE TO CONTROL THE CAR. THE GRIPS PRODUCE POSITIVE ENERGY TO MAKE HYDROGEN TO POWER THE FUEL CELL - NEGATIVE ENERGY LEAVES THE CAR IMOBILE. MOVING THE R.H. GRIP TO THE RIGHT TURNS THE CAR RIGHT AND TO THE LEFT FOR LEFT. MOVING THE GRIP FORWARD PRODUCES ACCELERATION AND REARWARDS FOR BRAKING. THE START BUTTON IS ON TOP OF THE GRIP. MOVING THE L.H. GRIP FORWARDS AND BACKWARDS MOVES THE REAR WING UP AND DOWN. THE AFTERBURNER BUTTON IS ON TOP OF THE GRIP. MOVING THE GRIP TO THE LEFT FIRES THE LASERS AND TO THE RIGHT ENGAGES ‘AUTODRIVE’!

SONAR SENSORS
THE SONAR SENSORS GIVE THE BATMOBILE THE ABILITY TO ‘SEE IN THE DARK’ AND TO AVOID OBSTACLES. THEY ARE WIRELESS CONNECTED TO THE SATELLITE NAVAVIGATION SYSTEM AND TO THE BATGRIPS. WHEN ‘AUTODRIVE’ IS SELECTED THE SONAR IS AUTOMATICALLY ENGAGED AND HELPS TO TAKE OVER CONTROL OF THE CAR.

AFTERBURNER
RUNS ON HYDROGEN - MULTIPLE CERAMIC-CARBON BURNER JETS. AFTERBURNER IS ENGAGED BY BUTTON ON L.H. BATGRIP AND IS CAPABLE OF ACCELERATING CAR FROM SUPERSPEED TO HYPERSPEED IN TWO SECONDS.

REAR WING
GIVES THE CAR EXTRA DOWNFORCE AND ADJUSTS FROM COCKPIT FOR CAR TRIM.

GROUND EFFECT DIFFUSERS
CREATE HUGE DOWNFORCE THROUGH GROUND EFFECT AERODYNAMICS.

LASERS
LASER BEAM GENERATORS IN NOSE ARE POWERED BY THE FUEL CELL. THEY ARE SONAR GUIDED AND CAN BE FIRED TO REMOVE OBSTACLES. SECONDARY FUNCTION IS HEADLIGHTS.

FRONT VENTURI

REAR VENTURI

GROUND EFFECT VENTURIES
DEVELOPED FROM FORMULA ONE TECHNOLOGY BUT MUCH MORE EFFECTIVE - THEY PRODUCE ENOUGH DOWNFORCE TO ALLOW BATMOBILE TO BE DRIVEN ON THE CEILING AT 100 MPH.

DIODE WHEEL SPOKES
PROVIDE POWER FOR THE CAR. THE POWER INCREASES FROM THE INNER RING OUTWARDS.

HYDROGEN STORAGE TANKS

HYDROGEN GENERATOR
BATMAN PRODUCES POSITIVE ENERGY - THIS IS COLLECTED THROUGH THE BATGRIPS AND FED TO THE HYDROGEN GENERATER AND BIO-MASS COLLECTOR. NEGATIVE ENERGY WILL NOT PRODUCE HYDROGEN THUS PROVIDING THE ULTIMATE ANTI-THEFT DEVICE.

QUIET MOVER
B.C.F. (BREATHABLE CARBON FIBRE) OUTER BODY SKIN REMOVES AIR BOUNDARY LAYER WHICH REDUCES DRAG, INCREASES SPEED AND ALLOWS THE CAR TO MOVE SILENTLY ABOUT ITS BUSINESS.

BLACK BOX
ELECTRONIC CONTROL UNIT IS POWERFULL AND SEMI-INTELLIGENT - CONTROLS ALL THE VEHICLE SYSTEMS.

CONTROL VALVE
DISTRIBUTES HYDROGEN TO FUEL CELL STACK AND AFTERBURNER.

FAN
REAR FAN POWER BOOSTS AFTERBURNER OR IT IS USED TO SUCK THE AIR BOUNDARY LAYER THROUGH THE BREATHABLE CARBON SKIN - REDUCING DRAG AND INCREASING DOWNFORCE.

ANTI-DECTECTION
BATMOBILE PROFILE AND B.C.F. SKIN PROVIDES AN ULTRA-FAST SHAPE WHICH IS INVISIBLE TO RADAR AND ALL KNOWN DECTECTION DEVICES.

OXYGEN INLET
OXYGEN INLET FOR FUEL CELL THROUGH B.C.F. SKIN

WATER EXHAUST
THE ONLY EMMISIONS FROM THE FUEL CELL STACK - WATER!

BATTERY
LITIUM-ION BATTERY PACK FOR STORING EXCESS ELECTRICITY.

VIRTUAL WHEELS
DIODE WHEEL SPOKE FORCE FIELD GENERATORS USE HIGH VOLTAGE ELECTRICAL ENERGY FROM FUEL CELL STACK. THE FORCE FIELD OPPOSES GRAVITY AND LIFTS THE BATMOBILE TO A LEVITATION POSITION 40MM ABOVE THE GROUND. THE VIRTUAL WHEEL MOTOR ROTATES THE FORCEFIELD - FORWARDS FOR ACCELERATION AND BACKWARDS FOR BRAKING. THE STEERING VECTOR IS GENERATED BY SLOWING ONE SIDE AND ACCELERATING THE OTHER. COUNTER-ROTATING WHEELS CAN CAUSE THE BATMOBILE TO SPIN ON IT’S OWN AXIS - A GREAT MANOEVRE FOR ESCAPING FROM AN ADVERSARY!

FUEL CELL STACK
HYDROGEN IONS FORMED BY A PLATINUM ELECTRODE RELEASE AN ELECTRON WHICH CREATES DIRECT CURRENT INTERNALLY. HYDROGEN IONS PASS THROUGH A ONE-WAY MEMBRANE WHERE THE BOND WITH THE OXYGEN IONS AND AN ELECTRON TO MAKE ELECTRICITY.

POWER SUPPLY
TO VIRTUAL WHEELS.

VIRTUAL WHEEL MOTOR

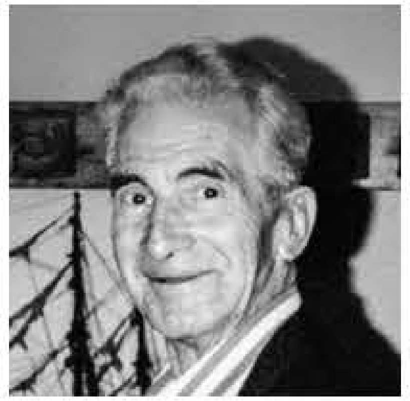
ANTI-DETECTION TRANSMITTER
PROVIDES A SECOND LEVEL OF PROTECTION. TRANSMITTERS ON TRAILING EDGE OF FRONT AND REAR ‘WINGS’ EMIT A HIGH FREQUENCY MICRO WAVE SIGNAL WHICH JAMS ALL KNOWN DECTECTION SYSTEMS.

CARBON STRUCTURE
THE BATMOBILE IS CONSTRUCTED FROM A NEW TYPE OF CARBON FIBRE WHICH 10 TIMES LIGHTER THAN STEEL AND 100 TIMES STRONGER. THE SKIN IS ALSO BREATHABLE.

‘IT’S PROBABLY NOT SURPRISING THAT 20 OF MY CLASSIC CARS ARE UNDER 700KG’

IMPORTANT PEOPLE IN GORDON'S CAREER

During Gordon's formative years and throughout his career, there have been many people who helped him, supported him and worked with him. And, as he puts it, 'A large proportion of them have become lifelong friends'.



BILL MURRAY

'My love of motor racing started very early in my life and that was due to my father's interest in cars and the sport. My childhood years were filled with motor cars and motor racing.'

ROMA MURRAY

'My mother would encourage me to pursue anything I had an interest in, which included my car building and racing, even though she was worried about my racing.'

TERRY MURRAY

'My brother lent me money to buy the Weber carburettors for my first racing car and he remained supportive throughout his life.'

STELLA MURRAY

'During our short courtship in South Africa in 1969 before I left for the UK, Stel already understood my dedication to motor racing. We were married six months later in Kensington and she has remained steadfastly supportive through all my automotive years.'

LES VERMAAK

'Les and I grew up together in Durban from the age of about five, and we shared interests and passions throughout our formative years. Les was like a brother to me.'

MALCOLM KINSEY

'Malcolm was at high school with me and shared my passion for motor racing. We helped and encouraged each other through our racing years.'

COLIN CHAPMAN

'Chapman was my hero during the 1960s and it was his approach to simple, lightweight design that I modelled myself on.'

RON TAURANAC

'Ron is a very talented and practical designer. He gave me my chance at Brabham and we always got on well professionally.'

JACK BRABHAM

'Jack was still driving when I started at Brabham in 1970. He was a true gentleman and was always easy to talk to.'

ALAIN DE CADENET

'Doing the Duckhams prototype sports-racing car for the 1972 Le Mans 24 Hours with Alain really helped to put me on the map.'

BERNIE ECCLESTONE

'To this day I don't firmly understand why Bernie fired the other Brabham design staff and kept me. It might well have been the offer from [Tecno boss] Pederzani but, whatever the reason, he believed in me, gave me a chance and always gave me a free hand with the technical side of the business. Bernie was, and still is, a racer at heart.'

PETE & MICHÈLE WEISMANN

'I first met Pete and Michèle when I was working on the Indycar project at Brabham in 1971 and from then on Pete and I worked together on several groundbreaking transmissions. They also became lifelong friends.'

DAVID NORTH

'Up until I employed David to work with me at Brabham in 1976, I was on my own in the design office. David learnt very quickly and became a great design partner for the Brabham period and later for my three years at McLaren. We worked very well together.'

PAUL ROSCHE

'Paul and I met when we took the BMW turbocharged engine in 1982 and we instantly got on well. Paul was a free-thinker, a genius and a very dear friend. Together we gave BMW their first Formula 1 World Championship and Le Mans win.'

WOLFGANG REITZLE

'Wolfgang was very instrumental in putting the McLaren F1 engine deal together and I always had a lot of respect for him.'

MANSOUR OJJEH

'Mansour was the spark of inspiration for the road car company at McLaren and was very supportive of me when I was setting up the operation. He remains a very dear friend.'

CARLO CHITI

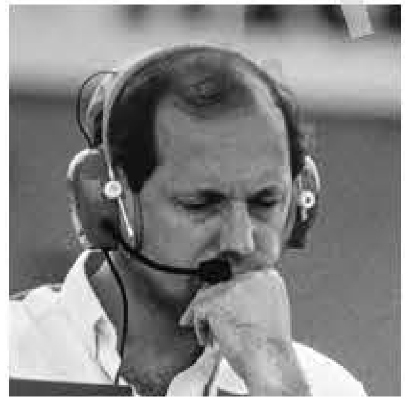
'Chiti was a larger-than-life Italian with a great history in motor racing. We had a mutual respect for one another and, although the Alfa Romeo years were exasperating at times, we achieved a lot together.'

CHRIS CRAFT

'I first met Chris in 1971 when I was designing the Duckhams LM that he drove with Alain de Cadenet in '72. Chris and I have remained very good friends and we went on to do the Rocket and the Lightning together.'

KARL-HEINZ KALBFELL

'Karl-Heinz was very much part of the BMW team with Paul Rosche and Wolfgang Reitzle, and he made things happen. He also became a very good friend.'



RON DENNIS

'Ron gave me a free hand at McLaren International, with the design and the technical side of the business. I also had a blank canvas when it came to setting up the road car business, building the team and designing the car. After the SLR, he made some bad management decisions. I left and McLaren Cars drifted for several years. We worked well together but we were never close socially. The McLaren years were a financial disaster for me.'

CREIGHTON BROWN

'Creighton was a true gentleman and we got on from day one. Creighton left McLaren International to set up McLaren Cars with me. We became very good friends.'

OSAMU GOTO

'Goto-san and I worked very closely on the MP4/4 design and the engine integration. Our working relationship continues with many different projects.'

TAKAAKA KIMURA

'Kimura-san and I met in the late 1980s and he was instrumental in making the LCC Rocket programme happen. Kimura helped a lot with the Yamaha parts procurement. More recently, I have worked with him again on Gordon Murray Design projects, so we've shared some 30 years of technical co-operation.'

JON FEIBER

'Jon is a senior partner at MOHR Davidow Ventures and it was Jon that believed in my vision for iStream and Gordon Murray Design. It is Jon's continued support that is helping iStream make automotive history. Jon is a great car and racing enthusiast, and I count him as a special colleague and friend.'

NEIL OATLEY

'When I arrived at McLaren International in 1986, Neil was the only good, experienced designer in the team and I entrusted a lot of the design to him for the 1989 and 1990 cars. We had similar lifestyle and tastes, and we got on very well both professionally and socially.'

NOBUHIKO KAWAMOTO

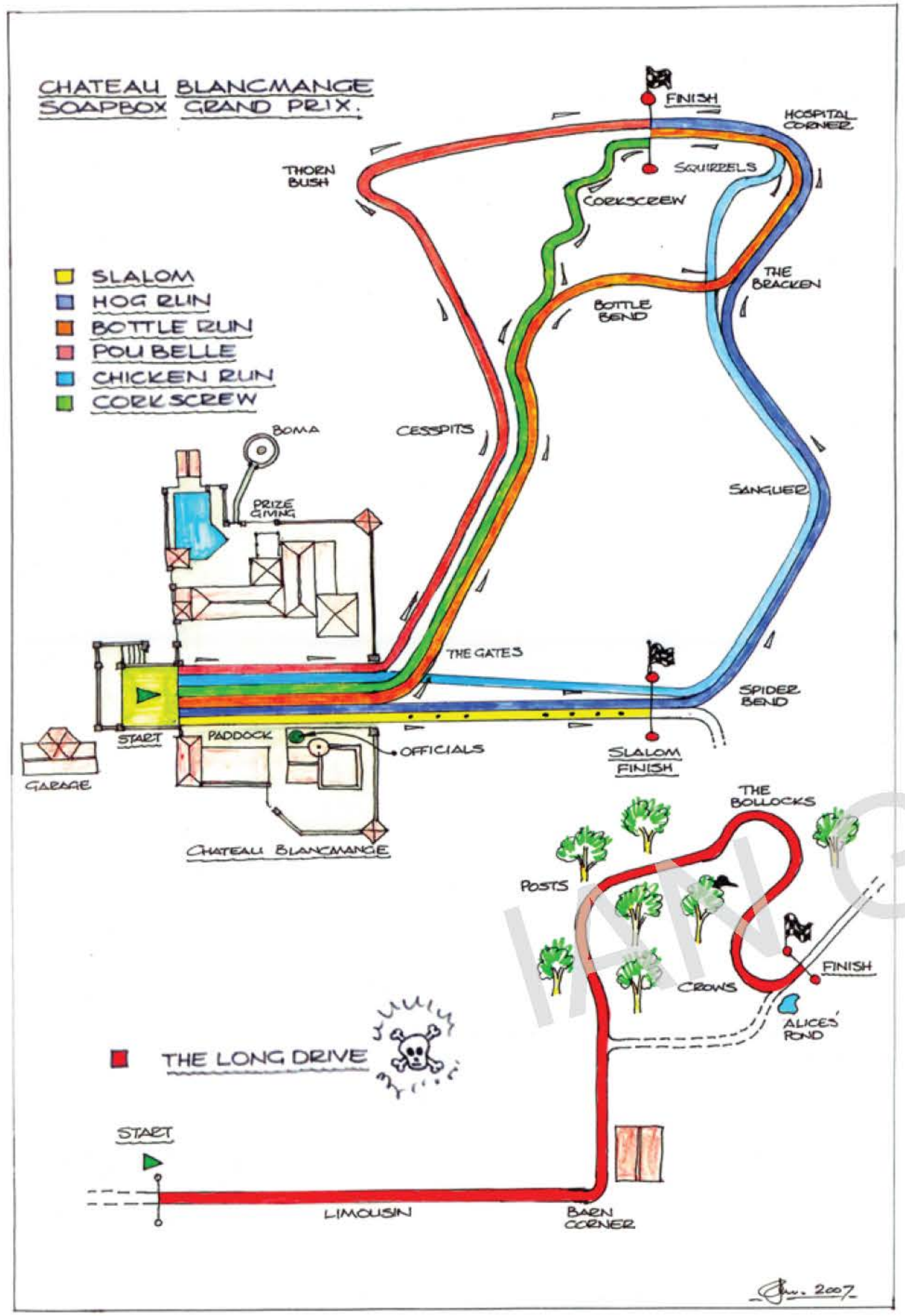
'Kawamoto-san and I had a great relationship. He was a fantastic leader and racer at heart. I'm sure that a lot of Honda's success in that period was down to his leadership.'

HERBIE BLASH

'Herbie and I ran the Brabham team for Bernie. We spent more than 15 years working and travelling together, and we developed a very close bond and relationship. Our friendship continues to this day.'

GEORGE HARRISON

'I met George in 1976 and we forged an instant bond. He remained a very close friend throughout my career and completed my circle of passion for both music and racing.'



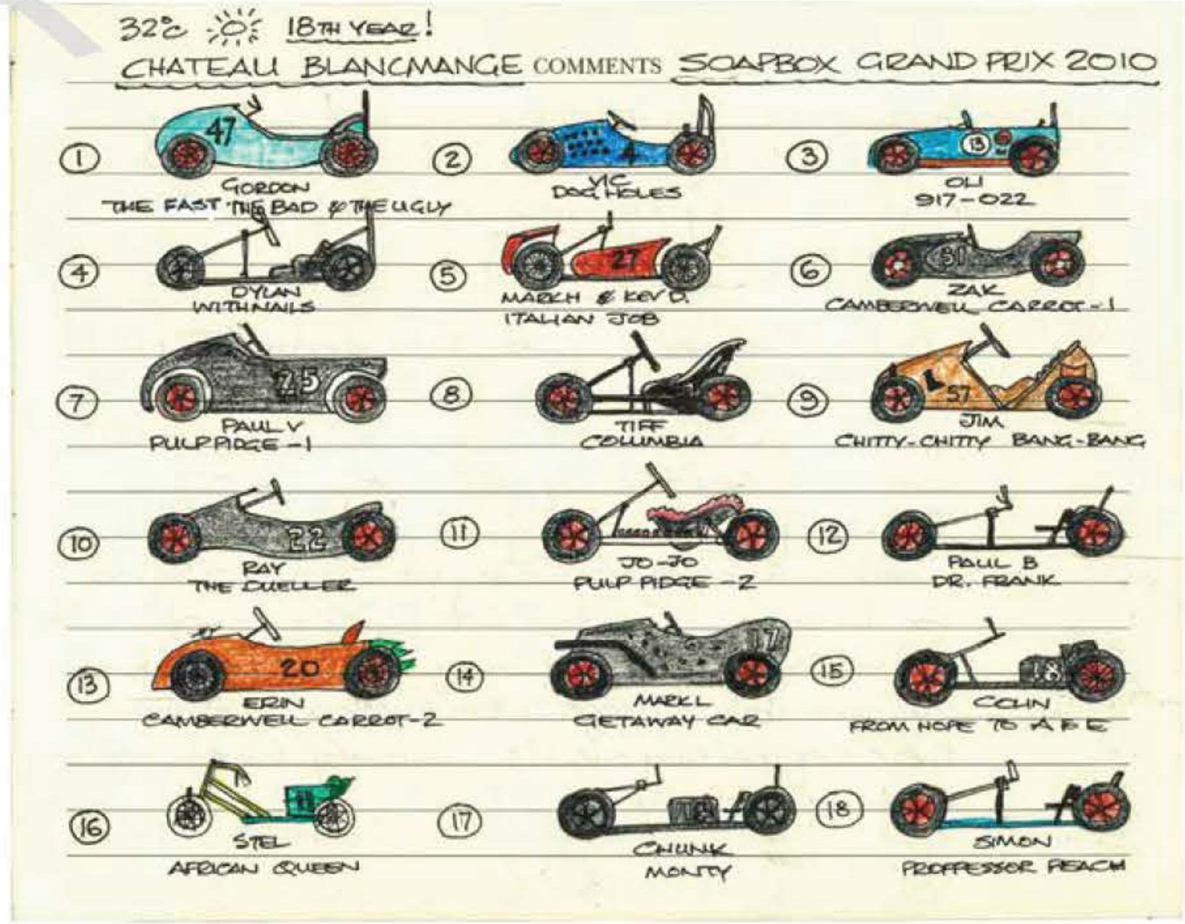
Above Seven soapbox tracks at Château Blancmange

Left The carting got very competitive

Top A split second before the pain (Gordon is on the left)

Above Gordon with his wife Stella at the prize-giving

Right The entry for the 2010 Soapbox Grand Prix


32°C 18TH YEAR!
CHATEAU BLANCMANGE COMMENTS SOAPBOX GRAND PRIX 2010
① 47 GORDON THE FAST THE BAD & THE UGLY
② VIC DOG HOLES
③ 13 OLI 917-022
④ DYLAN WITHNAILS
⑤ 27 MARCH & KEV D. ITALIAN JOB
⑥ 61 ZAK CAMBERWELL CARROT-1
⑦ 25 PAUL V PULPPIDGE-1
⑧ TIFF COLUMBIA
⑨ 57 JIM CHITTY-CHITTY BANG-BANG
⑩ 22 RAY THE DUELLER
⑪ JO-JO PULP PIDGE-2
⑫ PAUL B DR. FRANK
⑬ 20 ERIN CAMBERWELL CARROT-2
⑭ 17 MARK L GETAWAY CAR
⑮ 18 COLIN FROM HOPE TO A & E
⑯ STEL AFRICAN QUEEN
⑰ CHUNK MONTY
⑱ SIMON PROFFESSOR PEACH

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Bell, Justin *676, 679, 914*
Bellamy, Ralph *80, 174, 220*
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Blash, Herbie *116, 195, 241, 330, 356, 357, 358, 399, 435, 486, 625, 771, 910*
Blundell, Mark *676, 679, 913*
BMW engines *321, 325, 361, 364, 366, 372, 377, 380, 382, 383, 386, 387, 388, 389, 390, 393, 395, 401, 403, 407, 410, 415, 421, 426, 428, 439, 441, 443, 445, 450, 453, 455, 460, 461, 468, 469, 472, 475, 478, 684, 695, 698, 702, 703, 711, 721, 724, 736, 909*
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